Predictors of Adverse Neonatal Outcomes in Maternal Cardiac Disease

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ABSTRACT

BACKGROUND
Pregnancy-associated cardio circulatory changes—primarily, increase in heart rate, stroke volume, and cardiac output, as well as reduction in systemic vascular resistance, may threaten maternal outcome; which in turn has foetal and neonatal implications. We wanted to assess the impact of heart disease during pregnancy, study the neonatal outcomes of pregnancies in women with heart disease and identify predictors of adverse neonatal outcomes.

METHODS
Data of all pregnant women with documented heart disease who were admitted in a rural tertiary centre in Kerala over a period of 3 years was collected. Patients undergoing medical termination of pregnancy were excluded from the study. The neonatal outcomes of pregnancies in 100 women with heart disease, were evaluated.

RESULTS
In 100 mothers with heart disease, neonatal adverse events complicated 35% of pregnancies. In 31% cases, the babies were small for gestational age. There were 10 cases with Respiratory Distress Syndrome, 7 preterm babies and 6 cases with low Apgar scores. The live birth rate for pregnancies that continued beyond 20 weeks was 96%. NYHA class is a statistically significant predictor of neonatal events (p value 0.001). 14 out of 28 pregnancies with left heart obstruction had a neonatal complication, which was statistically significant (p value 0.050). Previous history of cardiac events was present in 9 cases and 88.9% of these patients developed a neonatal event (p value 0.000). The requirement of cardiac medications was also a significant predictor of neonatal events (p values- 0.004).

CONCLUSIONS
The management of pregnant women with heart disease requires a multidisciplinary team work for a good outcome. Early risk stratification, good antenatal care and early recognition of complications are important measures to improve the prognosis in these women.

KEYWORDS
Pregnancy, Heart disease, Neonatal outcomes, Predictors
BACKGROUND

1-3% of all pregnancies are complicated by maternal cardiac disease, an association that is responsible for about 20% of all maternal deaths. Pregnancy-associated cardio circulatory changes—primarily, increase in heart rate, stroke volume, and cardiac output, as well as reduction in systemic vascular resistance—may threaten maternal outcome: which in turn holds foetal and neonatal implications. The incidence of cardiac disease during pregnancy has remained stable for many years since the decrease in the occurrence of rheumatic heart disease has been compensated by an increase of pregnancy in women with congenital heart disease. In developed countries, survival of newborns affected by congenital heart disease is increasing as a result of complex surgical procedures performed in the first few years of life. As a result the cardiologists and obstetricians are today facing an increasingly large group of pregnant women with surgically corrected congenital abnormalities. Both acquired and ACHD predispose pregnant women and their offspring to a heightened risk of adverse events, particularly during labour and delivery. The obstetricians should have adequate information about cardiac diseases during pregnancy so that they can function effectively as a member of the team taking care of the patient. To provide appropriate obstetrical counseling and care, there is a need to refine the risk stratification. The frequency and predictors of neonatal complications in women with heart disease who received their obstetrical care at a rural tertiary care centre in Kerala were evaluated.

We wanted to assess the impact of heart disease during pregnancy, study the neonatal outcomes of pregnancies in women with heart disease and identify the predictors of neonatal complications in women with heart disease.

METHODS

In this case record-based study, the outcomes of pregnancies in 100 women with heart disease who received their obstetrical care at a rural tertiary care centre were evaluated. Heart disease in this group was congenital or acquired in origin. Patients with isolated mitral valve prolapse were excluded because this condition is not associated with an increased rate of pregnancy-related complications. Also excluded were 13 women with heart disease who underwent medical termination of pregnancy.

All pregnant women with heart disease receiving care in this hospital undergo standardized cardiac and obstetrical evaluations during their pregnancy. Their newborns were examined by a Paediatrician before hospital discharge. Outcomes of newborns who were subsequently admitted to paediatrics department for ongoing care were determined from the case records from that department.

Definitions of predictors and outcomes were determined by consensus between a cardiologist and obstetrician before data collection. Data were obtained from independent review of health and clinic records. Prior written permission was obtained for retrieving medical case records from the medical records library. Baseline data were collected before review of outcomes and included: maternal age, gestational age at 1st antenatal visit, New York Heart Association (NYHA) functional class at first antenatal visit, parity status, prior cardiac events (heart failure, transient ischemic attack, or stroke before present pregnancy), cardiac medications and heparin administered during pregnancy, prior cardiac surgical repair, evidence of central cyanosis, and nature of the underlying cardiac lesion.

Adverse neonatal outcomes were defined as prematurity (birth <37 weeks’ gestation), small-for-gestational-age birth weight (birth weight <10th percentile for gestational age), respiratory distress syndrome, neonatal death, or stillbirth. This study procedure received approval from the ethics committee of the institution.

Statistical analyses were performed for adverse neonatal outcomes. Potential predictors of adverse outcomes in pregnancies not ending in miscarriage (completed pregnancies) were examined with $\chi^2$ test. Potential predictors included baseline NYHA functional class, prior corrective surgery, prior cardiac events, and nature of underlying cardiac lesion. In view of the wide spectrum of cardiac lesions that were present as well as the presence of multiple types of lesions in a single patient, the mother’s cardiac lesion in each pregnancy was classified as present or absent in each of the following pathophysiological categories: left heart obstruction, right heart obstruction, left heart regurgitation, right heart regurgitation, The presence of obstruction, regurgitation, and left ventricular systolic dysfunction was defined by validated trans-thoracic echocardiographic (echo) indices obtained during the ante partum period. Valve areas used to define left heart obstruction were set at a level that could be hemodynamically significant in the presence of increased cardiac output in pregnancy. When ante partum echo was not performed, echo data within the preceding 2 years were used unless the patient had experienced a change in clinical status or undergone intervention.

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Shunt</td>
<td>Atrial or ventricular septal defect, patent ductus arteriosus, or sinus of Valsalva to right ventricle fistula</td>
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<tr>
<td>Left heart obstruction</td>
<td>Aortic valve area of &lt;1.5 cm², mitral valve area of &lt;2 cm², or left ventricular outflow tract peak gradient of &gt;30 mm Hg</td>
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<tr>
<td>Right heart obstruction</td>
<td>Tricuspid valve area of &lt;2 cm² or right ventricular outflow tract peak gradient of &gt;25 mm Hg</td>
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<tr>
<td>Left heart regurgitation</td>
<td>Moderate or severe regurgitation of aortic or mitral valve</td>
</tr>
<tr>
<td>Right heart regurgitation</td>
<td>Moderate or severe regurgitation of pulmonic or tricuspid valve</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>Systolic pulmonary artery pressure exceeding 50 mm Hg</td>
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Table 1. Definitions of Pathophysiological Categories

Statistically significant (p<.05) variables on univariate analysis were entered into a multivariate logistic-regression model with the significance level set at .01. To control for other factors that may influence outcome, the model included maternal age, parity status, gestational age at the baseline visit, twin gestations, and concurrent administration of heparin or cardiac medications.
RESULTS

A total of 100 cases were included during the study period. Neonatal events complicated 35% of pregnancies. In 31% cases, the babies were small for gestational age. The live birth rate for pregnancies that continued beyond 20 weeks was 96%. There was a case of fresh still birth following grade 2 abruption in a woman on treatment with aspirin (the patient had a history of acute inferior wall myocardial infarction following ASD closure). The mean age was 26 years with a standard deviation of 2.5. The youngest patient was 18 years of age and the oldest 39 years. There is no statistically significant association between maternal age and neonatal events (p value 0.107). Most of the patients were nulliparous or para-1. There were no grand multiparas in the study group. Parity was not a significant predictor of adverse neonatal events i. (p value 0.85). Most of the cases were class 1 or class 2. No patient in the study group had class 4 heart disease. All the cases with class 3 heart disease were complicated by a cardiac event. NYHA class is a significant predictor of neonatal events (p 0.001). The etiologies of the maternal cardiac lesions were congenital in 48 cases and acquired in 52 pregnancies. Etiological type of heart lesion was not a significant predictor of neonatal events (p values 0.240). Right heart obstruction was present in 3 cases, one among them was complicated with a small for date foetus. Right heart obstruction was not a significant predictor of neonatal events (p value 0.721). Right heart regurgitation was present in 4 cases. Right heart regurgitation was not a significant predictor of neonatal events (p values 0.676). Of the 28 pregnancies that occurred in women with left heart obstruction, 15 were in women with mitral stenosis and 5 were in those with aortic stenosis. In 8 pregnancies, the mother had combined aortic and mitral stenosis. The mean mitral valve area was 1.8±0.3 cm² (range, 1.2 to 2.0 cm²) in women with mitral stenosis. In those with aortic stenosis, the mean aortic valve area was 1.2±0.2 cm² (range, 0.7 to 1.5 cm²). Patients with aortic stenosis have valvular involvement, except for 1 patient with subaortic stenosis (with hypertrophic cardiomyopathy). The patient with Marfan syndrome had normal aortic root diameter. Left heart obstruction was a significant predictor neonatal events (p value 0.050). Left heart regurgitation was not a significant predictor neonatal events (p values 0.636). In 23 cases, the mother had undergone one or more of the following types of surgical repair before conception: (1) Closure of atrial septal defect (n=9), (2) Closure of ventricular septal defect (n=3). (3) Closed mitral valve commissurotomy (n=3), (4) Balloon mitral valvuloplasty (n=2), (5) Mitral valve replacement (n=3), (6) Dual valve replacement (n=1), (7) PDA ligation (n=2).

Prior surgical correction was not a significant predictor of neonatal events (p value 0.636). There was a previous history of cardiac events in 9 cases; 44.4% of these patients had cardiac complications and 88.9% had neonatal complications in the current pregnancy. Prior cardiac events was a significant predictor of neonatal events (p values 0.00). The majority of patients did not require cardiac medications. The commonly used drugs included digoxin (n=11), diuretics (n=9), antiarrhythmics (n=6) and anticoagulants (n=7). The requirement of cardiac medications during pregnancy was a significant predictor of neonatal events (p value 0.004). There were 2 cases of twin gestation. One among this was referred from a primary health center as a case of cardiac failure complicating twin gestation. She was later diagnosed to have peripartum cardiomyopathy. The other case had intraoperative pulmonary oedema during caesarean section. Twin gestation was a significant predictor of cardiac events (p 0.00) but not neonatal events (p 0.06).
DISCUSSION

The study provides an assessment of neonatal risk associated with pregnancy in women with heart disease who received appropriate antenatal care. Neonatal complications occurred in 31% of pregnancies, comparable to the 27.8% reported by Khairy P et al. However, the high foetal/neonatal mortality rate of 4% is not comparable with western studies. The low neonatal mortality observed in those studies may be due to greater vigilance in the care of pregnant women with heart disease or the avoidance of pregnancy by women in higher-risk groups. The rate of preterm labour (7%), respiratory distress syndrome (10%) and low APGAR scores at birth (6%) are comparable to previous studies by Khairy P et al. The high rate of small for gestational age foetuses (31%) is not comparable with western studies probably due to difference in the ethnic group studied and hence the difference in birth weights. Poor NYHA class and maternal left heart obstruction was predictive of neonatal events in prior studies and in the present study. The predictive role of maternal left heart obstruction on neonatal outcome identified in this study may be mediated by inadequate placental perfusion, which then results in foetal growth retardation, foetal death or premature labour. Indeed, foetal cardiac contractility and output are adversely affected by hypoxic acidemia resulting from uteroplacental insufficiency.

The requirement of cardiac medications during pregnancy correlated well with poor functional class and was a significant predictor of neonatal events. In contrast to previous studies by Shime J et al.,8 Whitemore R et al.9 and McFaul PB et al.10 prior cardiac surgery were not associated with complications in this study. The results are comparable to study by Siu S C et al.11 Operative status was not predictive of complications in this study, possibly due to the absence of hemodynamic or electrophysiological residua. Maternal age, parity, etiological type of lesion, right heart regurgitation, right heart obstruction and left heart regurgitation were not significant predictors of neonatal events. The results are comparable to the observations by Siu S C et al. from Canada.11,12 There were no cases with cyanosis, pulmonary artery hypertension or Eisenmenger syndrome in this study, probably because the results of earlier studies showed that medical termination of pregnancy is better in these cases. Hence, the previously reported predictive role of cyanosis and pulmonary artery hypertension on adverse neonatal outcome10 could not be established. The power of the study was increased by combining cardiac lesions with similar haemodynamics into one category, so as to identify independent predictors. However, some categories may not be predictive of complications because of small numbers. For instance, twin gestation was not found to be an independent predictor of neonatal events probably because there were only 2 cases in this category. A larger sample size may allow the identification of additional risk factors.

CONCLUSIONS

Neonatal complications occurred in 35% of pregnancies in women with heart disease and the most common complication was small for gestational age foetus. Poor maternal functional class left heart obstruction, prior cardiac events and the requirement of cardiac medications during pregnancy were significant predictors of adverse neonatal outcomes. Maternal age, parity and etiological type of lesion were not significant predictors of neonatal events. The management of pregnant woman with heart disease requires a multidisciplinary team work for a good outcome. Early risk stratification, good antenatal care and early recognition of complications are important measures to improve the prognosis of pregnancy in women with heart disease.

REFERENCES