Original Article

DOI: 10.7860/JCDR/2018/31904.11079

Heart Disease in Pregnancy-Evaluation of Spectrum, Association of Predictors with Obstetric Outcome and Need for Comprehensive Medical Care

Obstetrics and Gynaecology Section

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ABSTRACT

Introduction: Cardiac disorders of varying severity complicate nearly 1% of pregnancies and are an important cause of maternal morbidity and mortality. It is important to define the risk stratification of women with heart disease for optimal pre-pregnancy counselling and obstetric management.

Aim: To study the spectrum of heart disease in pregnancy, identification of various predictors of feto-maternal complications and comparison of the obstetric outcome in women with heart disease who received Comprehensive Medical Care (CMC) beginning at ≤28 weeks, with those who began Antenatal Care (ANC) supervision after 28 weeks.

Materials and Methods: A prospective observational study was conducted in the Department of Obstetrics and Gynaecology in Safdarjung Hospital (SJH), New Delhi, India, from October 2014 to March 2016. Pregnant women with heart disease attending the OPD/or delivering in labour room were scrutinised through the eligibility criteria. Out of the 66 eligible women, beginning antenatal supervision at ≤28 weeks of gestation were designated as Group A (n=32) who received CMC. Remaining women (n=34), who supervised after 28 weeks in the hospital for further management were designated as Group B. Analysis was done after applying appropriate tests: t-test, Chi-square test and univariate analysis, as applicable.

Results: Incidence of heart disease was 0.35% (71/21,000), out of which Rheumatic Heart Disease (RHD) was predominant. Left heart obstruction was the most common (29/66) predictor for adverse maternal cardiovascular and neonatal event, followed by baseline New York Heart Association (NYHA) Class>II (22/66). Cardiac complications were 2.4 times higher and cardiac mortality was ~3 times more in Group B as compared to Group A. Neonatal mortality occurred in 5.6% (2/36) women in Group B.

Conclusion: All pregnant women with heart disease should receive comprehensive multidisciplinary prenatal care. Early ANC supervision and extra prenatal surveillance is recommended according to pregnancy associated risk status. Women with ≥1 predictor of cardiac and neonatal events should be referred to a tertiary care centre for CMC.

Keywords: Antenatal care, Cardiac disease in pregnancy, Risk stratification

INTRODUCTION

Ample understanding of heart disease in pregnancy is essential for an obstetrician, since it is the primary indirect cause of maternal mortality, accountable for 0.5-2.7% of maternal deaths. Its incidence is ~1% of pregnancies (0.1-4%) [1]. The heart diseases encountered in pregnancy include RHD, Congenital Heart Disease (CHD), Ischaemic Heart Disease (IHD), arrhythmias and Cardiomyopathies (CMPs).

The spectrum of cardiac disease encountered in pregnancy is changing over the years, owing to now available novel and innovative treatment modalities for CHD, and better access to healthcare facilities [2,3]. Still, in developing nations like India, RHD remains the predominant contributor of heart disease (56-89%) [3].

Diagnosis and management of heart disease in pregnancy poses a strict challenge to the obstetrician in the backdrop of worsening haemodynamics by the physiological circulatory changes of pregnancy. Superimposed on that, cardioactive drugs, cardiac interventions and use of anticoagulants in pregnant females with prosthetic heart valves may also cause adverse feto-maternal outcome [4]. Thus, risk stratification becomes imperative for women with heart disease for optimal pre-pregnancy counselling and obstetric management. Various predictors for adverse maternal cardiac and neonatal events have been identified in the past; based on these predictors, different risk scores have been designed to predict cardiac complications, of which CARPREG risk score is the most widely accepted, and used and validated by previous researchers [5-8].

The maternal cardiovascular complications observed during pregnancy include cardiac failure, pulmonary oedema, arrhythmias, worsening of NYHA Class and cardiac death. Reported foetal and neonatal complications include preterm delivery, Small for Gestational Age (SGA), perinatal death and foetal cardiac disease [6, 9-11].

Various investigators have evaluated obstetric outcomes in women with cardiac diseases; however, most of these studies are retrospective [4,6,9] and there is paucity of data from the Indian subcontinent. Besides, none of the studies conducted so far has compared the impact of early vs late initiation of CMC on obstetric outcome in these women.

Keeping all this in view, the present study was designed to study the spectrum of heart disease in pregnancy observed in a tertiary care hospital and to identify and study the association of various predictors of maternal cardiovascular and neonatal complications. It also aims to compare the obstetric outcome in women with heart disease who received CMC beginning at ≤28 weeks with those who began ANC supervision later than 28 weeks.

MATERIALS AND METHODS

This was a prospective, observational study conducted in the Department of Obstetrics and Gynaecology in Vardhman Mahavir Medical College and SJH, New Delhi from October 2014 to March 2016, in collaboration with the Department of Cardiology and Paediatrics. The protocol was approved by the Institutional Ethical

Committee. A total of 71 pregnant women with heart disease (both congenital/acquired) attending the ANC OPD and/or delivering in the labour room of SJH during the study period were scrutinised through the eligibility criteria, of these 66 eligible women were enrolled, after taking their informed written consent.

Included women were patients with cardiac disease-both congenital and acquired. The exclusion criteria were i) any systemic illness which is likely to adversely affect the feto-maternal outcome, like diabetes, renal disease, chronic hypertension, thyroid disorders, auto-Immune disorders, bronchial asthma etc., ii) women with severe anaemia (<7 gm%).

Sample size calculation was based on the objective to assess the predictors of maternal cardiovascular and neonatal events in women with heart disease. Assuming effect size to be 0.7, level of significance 5% and power as 95%, a minimum sample of 30 pregnant women with heart disease was required for the study including lost to follow up, as per G Power 3.1 software. All findings were recorded on a predefined case proforma, and deciphered at the end of the study.

Out of the included 66 women, those attending the ANC OPD, beginning at ≤28 weeks of gestation were designated as Group A (n=32). This group received CMC, i.e., co-ordinated multidisciplinary (cardiac, obstetric and paediatric) care from their first baseline visit at the hospital (≤28 weeks). Remaining women (n=34), who were supervised later than 28 weeks in the hospital for further management were designated as Group B. Two amongst the included women in whom pregnancy was risky and hence ideally requiring therapeutic abortion (Eisenmenger's disease) and pulmonary hypertension, presented late to the hospital. Hence, termination could not be offered as per the legal laws of country [12].

Women in both groups, were interviewed for detailed history (with special reference to symptoms of heart diseases) and a thorough medical examination was performed. The predictors of maternal cardiovascular events were documented (NOPE criteria-NYHA Class, left heart obstruction, prior cardiac event/arrhythmia left ventricular ejection fraction) [4,9-11] and risk scoring was done based on CARPREG risk score [8]. The predictors for neonatal events were also noted [3,6]. Definition of predictors and outcomes were determined by consensus between cardiologist and the obstetrician at the start of the study.

All women were followed from inclusion till one week post delivery. At each visit, their NYHA vstatus was re-evaluated. Criteria for hospital admission were i) signs and symptoms of worsening of cardiac status/NYHA Class or appearance of new onset symptoms, ii) NYHA Class III or IV, iii) gestational age of 36 weeks, irrespective of NYHA Class, iv) women on anticoagulant therapy for switchover of the same, whenever required.

Maternal outcome variables were any cardiac complication, maternal obstetric morbidity, miscarriage, mode of delivery, gestational age (weeks) at delivery, maternal mortality (cardiac and non-cardiac death) and presence of predictors for maternal cardiovascular and neonatal events.

Foetal outcome variables were prematurity, birth weight (kg) (≥2.5 or <2.5), appropriate for gestational age (AGA)/SGA, APGAR SCORE at one and five minutes, congenital anomalies, NICU admission with indication and perinatal death.

STATISTICAL ANALYSIS

Data was analysed with SPSS version 21.0 for windows. Appropriate statistical tests (Chi-square, t-test and univariate analysis) were applied, as required, and p-value of less than 0.5 was considered significant.

RESULTS

Amongst the 21,000 deliveries which occurred in the hospital during the study period, 71 women were diagnosed with heart disease, thus making an incidence of 0.35%. However, for further analysis, five women were excluded from the study due to associated comorbidities.

The mean age of the women enrolled in the study was 25.33±3.3 years. Out of them, 60.6% women were multigravida. Mean gestational age at baseline ANC visit was 27.3±7.6 weeks. A total of 13.6% women were diagnosed with heart disease during the

Demographic and maternal characteristics	Total cases (n=66)	
	Number	Percent (%)
Maternal age (years)		
• <20	01	1.5
• 20-25	33	50.0
• 25-30	29	43.9
• 30-35	02	3.0
• >35	01	1.5
Parity		
• Primi	26	39.4
• Multi	40	60.6
Residence		
• Urban	23	34.8
• Rural	43	65.1
Religion		
• Hindu	48	72.7
• Muslim	17	25.8
• Sikh	01	1.5
• Christian	00	0.0
• Others	00	0.0
Multiple pregnancy	3	4.5
Educational status		
• Illiterate	11	16.7
• Primary	26	39.4
• Middle	25	37.9
• Graduate	04	6.0
Occupation		
• Housewife	60	90.9
• working	06	9.0
Socioeconomic status (modified Kupuswami classification) [13]		
• Upper	00	0.0
• Upper middle	02	3.0
• Lower middle	35	53.0
• Upper lower	26	39.4
• Lower	03	4.5
Time of diagnosis of heart disease		
• Pre-pregnancy	57	86.4
• During pregnancy	09	13.6
Gestational age at first visit		
• <20	10	15.1
• 20-28	22	33.3
• 28-32	16	24.2
• 32-36	13	19.7
• >36	05	7.6
NYHA classification at baseline visit		
• Class I	29	43.9
• Class II	16	24.2
• Class III	10	15.1
• Class IV	11	16.7

[Table/Fig-1]: Demographic and baseline maternal characteristics of all women.

current pregnancy. The present study observed that 68.1% of cases presented in baseline NYHA I-II Class [Table/Fig-1].

Analysing the spectrum, RHD was the most common (76.5%), followed by CHD (21.9%) and CMP (11.8%). Mitral Stenosis (MS) was the most common valvular lesion observed (79.6%). Septal defects were the most frequent CHD (VSD > ASD) [Table/Fig-2].

Amongst the women with surgically corrected cardiac lesions, 83.3% presented in NYHA I/II at baseline visit as compared to 57.4% in the uncorrected group. Out of the total cases in NYHA III/IV at baseline visit, 83.3% were un-operated, while only 16.7% were surgically corrected.

Risk factors for adverse feto-maternal event (one or more) were present in 65.1% of all cases. Left heart obstruction was the most frequent (44.0%), followed by baseline NYHA Class>II (33.3%). On univariate analysis, baseline NYHA Class>II was found to be predictive of both adverse maternal cardiac and neonatal complications (p=0.006, OR=7.810 and p=0.003, OR=6.333 respectively). Multiple gestation was also observed to be statistically predictive of adverse neonatal complications (p=0.040, OR=23.897) [Table/Fig-3].

Comparing the obstetric outcome in Group A and Group B, cardiac complications (2.4 times) and cardiac mortality (~3 times were higher respectively in Group B; however, the difference was not statistically significant (p-value=0.6526 and 0.614 respectively). Obstetric complications were comparable in both the groups (p-value=0.726). The rate of LSCS was also found to be higher in Group A and the proportion of LSCS for cardiac indication was almost two times higher in this group i.e., 35.7 vs 18.1%. Women in Group B exhibited higher rate of preterm labour and SGA babies (1.7 times each) and 5.6% neonatal deaths. Mean birth weight and mean gestational age at delivery were comparable in both

Type of cardiac disease	Women receiving CMC (≤28 weeks) (n=32)		Women receiving after CMC (≤28 weeks) (n=34)	
	Number	Percent(%)	Number	Percent(%)
Rheumatic heart disease (RHD)	19	59.4	26	76.5
Congenital heart disease (CHD)	07	21.9	03	8.8
Cardiomyopathy (CMP)	02	6.2	04	11.8
Multiple cardiac disease • RHD+CHD • RHD+CMP	04 04 00	12.5	01 00 01	2.9

[Table/Fig-2]: Types of cardiac disease.

Predictors	Total cases (n=66)		Univariate regression	
	Number	Percent (%)	p-value	Odd ratio
Predictors for adverse maternal cardiac event (NOPE criteria)				
Baseline NYHA>II	22	33.3	0.006	7.810
Total mitral valve area <2, Left ventricular outflow tract gradient >30 mmHg	29	44.0	0.581	0.686
Prior cardiac event	04	6.0	0.095	5.889
Ejection fraction <40%	06	9.0	1.000	1.000
Predictors for neonatal events				
NYHA >II or cyanosis	22	33.3	0.003	6.333
Maternal left heart obstruction	29	44.0	0.790	0.859
Smoking during pregnancy	-	-	-	-
Multiple pregnancy	3	4.5	0.040	23.897
Use of oral anticoagulants	5	7.6	0.093	5.036
Mechanical valve prosthesis	4	6.0	0.274	3.133

[Table/Fig-3]: Identification of predictors for adverse maternal cardiovascular and neonatal events.
*analysed using univariate logistic regression; TMVA=Total Mitral Valve Area; LVOTG= Left Ventricular Outflow Tract Gradient

Parameters	Women receiving CMC (≤28 weeks) (n=32)		Women registered> 28 weeks (n=34)		p-value
	Number	Percent (%)	Number	Percent (%)	
Cardiovascular complications (at least one of the following)	5	15.6	7	20.6	0.6526
Heart failure with pulmonary oedema alone	1	3.1	2	5.9	0.428
Arrhythmias	1	3.1	1	2.9	1
Worsening of NYHA (≥2 class)	1	3.1	1	2.9	1
Urgent cardiac Surgical intervention	1	3.1	0	0	0.485
Cardiac Mortality	1	3.1	3	8.8	0.614
Obstetric complications (at least one of the following)	3	9.3	3	8.8	0.726
PIH	3	9.3	3	8.8	1
APH/PPH/PROM/ PPROM	0	0	0	0	0
Non cardiac Mortality	0	0	0	0	0
Mode of delivery					
Normal vaginal delivery	18	56.3	17	50	0.7904
Operative vaginal delivery	1	3.1	1	2.1	0.4999
LSCS obstetric indication	9	28.2	9	26.47	0.604
LSCS cardiac indication	2	6.25	5	14.71	0.604

[Table/Fig-4]: Comparision of maternal complications in women who received CMC beginning ≤28 weeks and those who registered after 28 weeks.*
*analysed using Chi-square and fisher exact test

Parameters	Women receiving CMC (≤28 weeks) (n=33)* *one multiple gestation		Women registered after 28 week (n-=36)* *two multiple gestation		p-value
	Number	percent (%)	Number	percent (%)	
Abortion	2	6.0	0	0	0.225
SGA	5	15.1	10	27.8	0.251
Preterm labour	5	15.1	9	25.0	0.378
Foetal death	1	3.0	1	2.8	1
Neonatal death	0	0	2	5.6	0.494
Mean GA at delivery (weeks)	37.3±3.35		37.43±2.08		0.8506
Mean birth wt.(kg)	2.52±0.56		2.48±0.62		0.7961
Congenital anomalies	0	0	0	0	-

[Table/Fig-5]: Comparison of foetal complications in women who received CMC beginning ≤28 weeks and those who registered after 28 weeks.*
*analysed using chi-square and fisher exact test

Risk score	Cardiac events (%) in Group A	Cardiac events (%) in Group B
0	0% (0/12)*	9% (1/11)**
1	18.7% (3/16)#	11.1% (1/9)##
>1	50% (2/4)$	35.7% (5/14)$$

[Table/Fig-6]: Comparison of association of cardiovascular events with risk score in Group A and B.
*0 score was present in 12 patients and none had cardiac events
**0 score was present in 11 patients and 1 had cardiac events
#1 score was present in 16 patients and 3 had cardiac events
##1 score was present in 9 patients and 1 had cardiac events
$> 1 score was present in 4 patients and 2 had cardiac events
$$> 1 score was present in 14 patients and 5 had cardiac events

the groups. No gross congenital anomaly or cardiac defect was observed in either of the groups [Table/Fig-4,5].

Comparison of association of cardiovascular events with risk score in both the groups-In Group A women with risk score 0,1 and >1, the observed cardiac events were 0%, 18.7% and 50% respectively, while in women in Group B, the cardiac event rate was 9%, 11.1%, and 35.7% with risk score 0, 1 and >1 [Table/Fig-6].

DISCUSSION

In the present study, heart disease was found to complicate 0.35% of pregnant population. This was similar to the incidence reported by researchers from Nepal [5,14]. However, it was quite low as compared to other investigators [4,9,10]. This difference may be attributed to those facilities being purely higher referral centers, catering only to high risk population, as opposed to our institution drawing both low risk and high risk women.

Most of the women in the current study were in 20-30 years age group, similar to other Indian studies [4,9,15] but different from western literature which have reported a higher age group [6,7]. This probably reflects a lower age of marriage and child bearing in the Indian population. In consonance with observations of Indian, European and sub-Saharan investigators, majority (60.6%) of the women in the present study were multigravida [3,6,16]. However, a Belgian study reported a relative preponderance of primigravidae. This may be due to the authors focusing only on women with CHD (including a number of complex cyanotic heart diseases) which often leads to early diagnosis in the first pregnancy [6]. A large proportion of women presenting as NYHA Class I or II in the current study, was similar to that noted by previous studies [4,7,9,12,17].

Amongst the study population, the relative predominance of RHD over CHD is congruent to other Indian researchers [4,9,15]. But, this is at variance with the western population, in which CHD was observed to be the most prevalent cardiopathy [6,7,17]. This disparity among Indian and western realms is analogous to the difference in status of healthcare between the two. The higher proportion of RHD in Indian scenario emulates the poor health infrastructure and lesser access to the available health services, besides highlighting the inadequacy of treatment of streptococcal infection in adolescent girls. Also, the higher incidence of CHD in developed countries is reflection of recent advances in paediatric cardiology and heart surgery there, making possible for more such women to reach the child bearing age.

Out of the total cohort of women with RHD, MS was the most common valvular lesion, followed by mitral regurgitation. This was akin to the past reviews across the world [4,9,15,16].

Scrutinising the risk factors for adverse feto-maternal event, baseline NYHA Class >II was found to be predictive of both maternal cardiac and neonatal complications on univariate analysis. Multiple gestation was also observed to be significantly predictive of neonatal complications. No other predictor was significantly associated with adverse events. These observations were dissimilar to those of Siu SC et al., who concluded that all the four predictors (NOPE) were predictive of the combined likelihood of either a primary or secondary cardiovascular event [7]. Drenthen W et al., have also reported NYHA functional class>II, left heart obstruction and history of arrhythmia, to be independent predictors of maternal cardiac complications; though decreased systemic ventricular function was a univariate predictor of cardiac complications [6].

The current study researchers observed that all the cardiac complications, excluding one case of worsening of NYHA class≥2, occurred in the cases where at least one predictor was present; however, no statistical significance could be established between the occurrence of cardiac events and presence/absence of any predictor. This was comparable to conclusions of Stangl V et al., who stated that women at high-risk (with presence of anyone predictor) had a 6.1 fold higher maternal complication rate [18]. This accentuates the importance of increased intensity of antepartum surveillancsse in women with heart disease, with identifiable risk factors, in a tertiary care facility for optimal outcome.

In the present study, foetal/neonatal complications were found to be 1.5 times higher in presence of at least one predictor, as compared to when none of the above predictors was present. This was in synchrony with the inferences of Siu SC et al., [7]. It again emphasises the importance of educating the clinicians, even at the primary health level, about early identification of predictors in such women, and their timely referral of patients to higher centre for multidisciplinary management.

Various studies, conducted across the world, have shown the adverse obstetric outcomes in cardiac diseases [4,6,9,15,16,18-20] but none has defined a cut off gestational age for CMC till date. Contrasting the obstetric outcome in Group A and B in the present study, revealed that cardiac complications and cardiac mortality rates were1.3 times and 2.8 times higher in Group B (who registered after 28 weeks). The obstetric complications were comparable in both the groups, the rate of induction was 1.5 times higher in Group B. Also, it was observed that the rates of prematurity and SGA neonates were 1.7 times higher in Group B though Mean birth weight and mean gestational age at delivery and percentage of foetal demise were comparable in groups. There was no neonatal mortality in women who received CMC ≤28 weeks. All these observations emphasise the significance of prompt diagnosis, pre-pregnancy counselling, risk stratification, individualised treatment and early initiation of state of the art CMC in a multidisciplinary setting, to optimise obstetric outcome in this subset of population.

In this study, all four cardiac deaths occurred in women with risk score >1. Similarly, Siu SC et al., also reported all three maternal deaths occurred in risk score>1 [7]. Studying the association of adverse cardiac events with absence or presence of risk factors between the two groups, it was found that in Group A, the observed cardiac events with risk score 0, 1 and >1 were 0%, 18.7% and 50% respectively, as compared to 5%, 27% and 75% respectively, according to CARPREG risk score [5-8]. However, in Group B, the observed cardiac events with risk score 0, 1 and >1 were 9%, 11.1% and 35.7% respectively. These observations suggest that in a woman with heart disease with absence of any predictor of cardiac event (risk score 0), risk of adverse cardiac events can be minimised, if she starts receiving CMC from early or mid-gestation. However, in the presence of any predictor, there is a definite risk of cardiac and neonatal complications, which persists despite the provision of early multidisciplinary CMC. The aforesaid inferences were disparate from Khairy P et al., who validated the CARPREG risk score [17]. But were largely similar to Drenthen W et al., who reported that CARPREG risk score was performed inadequately and largely overestimated the risk [6].

LIMITATION

Small sample size of the study owing to limited time constraints for sample collection (since patient had to be followed up till delivery) was the main limitation. Also, absence of routine foetal/neonatal echo in our set sup, due to financial constraints could cause underreporting of babies with CHD; inclusion of same would have further altered the foetal outcome.

CONCLUSION

Heart disease in pregnancy is an important cause of maternal morbidity and mortality, implicating multidisciplinary management. All women and adolescent girls attending OPD should undergo a thorough cardiovascular evaluation for any existing heart disease. All these women should be screened for presence of any predictor of cardiac and neonatal events. Women with one or more predictor should be referred to a tertiary care centre for CMC. A policy of

watchful expectancy for adverse cardiac and neonatal events should be followed.

ACKNOWLEDGEMENTS

We cannot repay in words, and in deed, love and thanks to all our patients suffering from heart disease, for their contribution towards making this research reach a successful zenith. We hereby pay our sublime observance and cordial thanks to all of them, besides wishing them a speedy recovery.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jul 26, 2017**
Date of Peer Review: **Oct 30, 2017**
Date of Acceptance: **Dec 04, 2017**
Date of Publishing: **Jan 01, 2018**