Original Research Article

Fetomaternal outcome of pregnancies complicated by cardiac disease

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Abstract

Objectives: The aim of this study was to assess the Fetomaternal outcome of pregnancies Complicated by Cardiac Disease. **Methods:** This is an observational study that includes prospective analysis of patients admitted in labour room, at Narayana Hrudayalaya Institute of Medical Sciences with pregnancy complicated by heart disease. Data was collected from 110 women during the time period from November 2013 to September 2015. **Results:** Out of 3588 cases delivered in the hospital, incidence of pregnancies complicated by heart disease was 3.06%. 43 patients (39%) were in the age group of 21-25 years.In 30% (n = 33) women, the diagnosis of heart disease was made during pregnancy and labour. Principal etiology was Rheumatic in 46% (n = 50), Congenital in 32% (n = 35), MVP in 9% (n = 10), cardiomyopathy in 7% (n =8) and 6% had rheumatic superimposing on congenital heart disease, arrhythmias, dissecting aneurysm of aorta.Septal defects were the most common form of congenital heart disease. 42 patients (38%) underwent surgical and nonsurgical (PTMC) interventions before pregnancy in both congenital and rheumatic group. PTMC in 11, valve repair in 6, and valve replacement in 10 patients. 5 patients underwent PTMC in antenatal period. Patients in NYHA class I & II (n = 89, 80.9%) had fewer maternal complications and their babies had a higher birth weight than those in NYHA class III&IV (n = 21, 19%). 69% (n = 76) had term deliveries, 17% (n = 19) had preterm deliveries, and 12% (n = 14) had abortions. 40.6 % patients had vaginal deliveries, 59.3% had caesarean section. Maternal mortality was 3.63% (n = 4) and maternal cardiac complications occurred in 10%, predominant being CCF. 61 patients had live birth with normal birth weight, 35 patients had low birth weight, 1 patient had intrauterine death and 4 patients had early neonatal death, 3 due to prematurity, 1 due to birth asphyxia due to shoulder dystocia. **Conclusion:** Pregnancy in women with heart disease is associated with significant cardiac and neonatal complications,despite state-of-the-art obstetric and cardiac care. Multidisciplinary approach should be adopted in the management of cardiac patient to minimize maternal and neonatal complications. Rheumatic heart disease was the predominant type. Patients in NYHA class I and II had abetter maternal and fetal outcome than those in NYHA class III and IV. Surgical correction of the cardiac lesion prior topregnancy was associated with better pregnancy outcome. Pregnant women with prosthetic valves tolerated pregnancy well.

Key words: Pregnancy, rheumatic heart disease, congenital heart disease, CCF, low birth weight.

Introduction

Cardiac disorders of varying severity complicate approximately 1% of pregnancies[1-5]. Cardiovascular abnormalities are considered the most important non obstetric cause of morbidity and mortality during pregnancies[6]. The risks of perinatal and maternal morbidity are dependent upon the underlying cardiac lesion.Rheumatic heart disease(RHD) and congenital heart disease(CHD) are currently the most frequent cardiac disease found in women of child bearing age[7]. Prevalence of pregnancy complicated by RHD has decreased in developed countries. The former ratio of 3:1 for RHD to CHD in series of pregnant women with cardiac disease is now reversed in developed countries[8].

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But in developing countries like India RHD is still predominant& comprises 56-89% of all cardiac disease in pregnancy[1,9-10]. CHD complicates 1% of all live births in the general population but occurs more frequently in the offspring (about 4–5%) of women with CHD[11].

The improvement in cardiovascular surgery has improved the prognosis of congenital lesions and many women even with severe defects are now reaching the child bearing age increasing the incidence of pregnancies with congenital heart disease. The most dominant rheumatic lesions are mitral stenosis(80%),followed by aortic stenosis (10%); mitral regurgitation (6.6%)& aortic regurgitation(2.5%)[12]. Increased maternal morbidity &unfavourable fetal outcome were seen mostly in patients with moderate to severe mitral stenosis and aortic stenosis.

Patients who undergo percutaneous transvenous mitral commissurotomy(PTMC) or valve surgery (repair/replacement)before pregnancy appear to have fewer complications than women who are treated medically. The reported maternal mortality rate ranges from 0.4% in patients with New York Heart Association (NYHA) classification I and II to 6.8% or higher among patients with classification III and IV severity[13].

Heart disease complicating pregnancy and labour is a real problem in India, especially as most of the maternity centres have to servewomen from low socio- economic group who usually seek help either when cardiac failure supervenes or when labour is well advanced. Therefore in spite of all modern advances in the management of cardiac patients it is still one of the leading causes of maternal mortality and fetal death in India. But with better understanding of cardiovascular

physiology, better medical treatment and advent of cardiac surgery, it is possible for a woman to reach the reproductive age, go through pregnancy and labour without much deterioration in her cardiac status.

A multidisciplinary approach is required in management of an obstetric patient with heart disease consisting of an obstetrician, cardiologist, neonatologist & anaesthesiologist[1].

The purpose of this study is to analyse the pregnant women with heart disease and thereby to assess the influence of cardiac disease on pregnancy and delivery in terms of maternal and fetal outcome.

Aim

To assess the maternal and perinatal outcome of pregnancies complicated by cardiac disease

Objectives

To compare with background population and other similar studies and evaluate

1. The incidence of cardiac disease complicating pregnancy.
2. Pre pregnancy awareness of cardiac disease.
3. Outcome in booked and unbooked pregnancies.
4. Outcome of interventions during pregnancy.
5. Mode of delivery.
6. Stay in hospital.
7. Maternal morbidity and mortality.
8. Fetal outcome.
9. Contraception in women with cardiac disease.

Materials and methods

Study site

Data was collected from the case records for prospective analysis from NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, Bangalore.

Study population

All the antenatal patients with cardiac disease admitted to NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, as inpatients.

Study design

This was a prospective observational study that included prospective analysis of patients admitted to NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, with pregnancy complicated by heart disease.

But we consider all the relevant patients satisfying the inclusion criteria, who got admitted during the period from November 2013 to September 2015 in NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, Bangalore.

Period of study

November 2013- September 2015.

Inclusion Criteria

Pregnancy with heart disease, admitted to NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, Bangalore.as in-patients.

Exclusion Criteria

1) Pregnancy with heart disease treated on outpatient basis.
2) CCF due to medical comorbidities like anaemia, thyroid disease

Methodology

Study was conducted on all pregnant women with cardiac disease admitted in NarayanaHrudayalaya Institute of Medical Sciences, Mazumdar Shaw Medical Centre, Department of Obstetrics, Gynaecology and Reproductive Medicine, Bangalore during the time period November 2013 to September 2015.

All pregnant women with congenital or acquired cardiac lesions or those who developed peripartumcardiomyopathy or those with other lesions admitted to or referred to the study centre for delivery were eligible for enrolment.

Data was collected prospectively from 110 pregnant women with heart Disease admitted in antenatal ward, which were booked at our hospital or which were unbooked/booked at other hospitals and were referred to us for delivery or with maternal complications.

Detailed history

If the heart disease was diagnosed prior to pregnancy history was elicited about the age at which symptoms were noticed, whether she sought cardiac consultation. History of joint pains, fever, recurrent attacks of tonsillitis, skin diseases was taken. Details of treatment history, prophylaxis for endocarditis, number of hospital admissions, cardiac intervention prior to pregnancy.

All women with heart disease were evaluated clinically by both Obstetrician and Cardiologist. ECG and Echocardiography were routinely performed. The patients were classified according to New York Heart Association functional class.

General examination and systemic examination

Pallor, cyanosis, clubbing, lymph nodes, jaundice, engorged veins, oedema, thyroid swelling, teeth and gums were examined.

Cardiovascular system examination

Pulse: rate, rhythm, character, volume.

Blood pressure

Auscultation: character of first and second heart sounds, character of murmur, basal crepitation.

Obstetric examination

It included fundal height, lie, presentation, fetal heart rate. Per vaginal examination was done if patient is in labour.

Women were advised on the routine antenatal care such as importance of rest, taking iron and folic acid supplementation and special care such as avoidance of infection, frequent visits and early visit to the clinic if there is anydeterioration of health condition.

Vaginal delivery was the aim. Caesarean section was done only with clear obstetric indications. Contraceptive advice was given for all the delivered patients.

Based on present clinical condition, outcome in booked and unbooked pregnancies, outcome of interventions during pregnancy, mode of delivery, stay in the hospital, maternal morbidity and mortality and perinatal outcome will be studied.

Neonatal outcome was analysed based on APGAR score, prematurity, birth weight, birth defects, still birth, IUGR. All neonates were examined by paediatrician.

Statistical methods

The data was entered in Microsoft excel and the analysed with Statistical Packages of Social Sciences (SPSS version 21). All analysis was considered statistically significant at 5% level (p value <0.05).

Observations and results

In Narayana Hrudayalaya Institute of Medical Sciences, Departmentof Obstetrics, Gynaecology and Reproductive Medicine at Bangalore during the period from November 2013 to September 2015 there were 3588 deliveries. During the same period there were 110 cases admitted with pregnancy complicated by heart disease, giving an incidence rate of 3.06%.

Table 1: Incidence of cardiac disease in pregnancy

Total no of deliveries	No of cardiac patients	Incidence
3588	110	3.06 %

Table 2: Distribution of cases as per socioeconomic class

SE Class	No of cases	Percentage
Upper (I)	12	10.90 %
Upper middle (II)	31	28.18 %
Lower middle (III)	40	36.36 %
Upper lower (IV)	20	18.18 %
Lower (V)	7	6.36 %

Table 2 shows the distribution of cases according to their socioeconomic class (as per modified Kuppuswamy classification). 10.90% of patients belonged to class I, 28.18% belonged to class II, 36.36% belonged to class III, 18.18% belonged to class IV and 6.36% of patients belonged to class V.

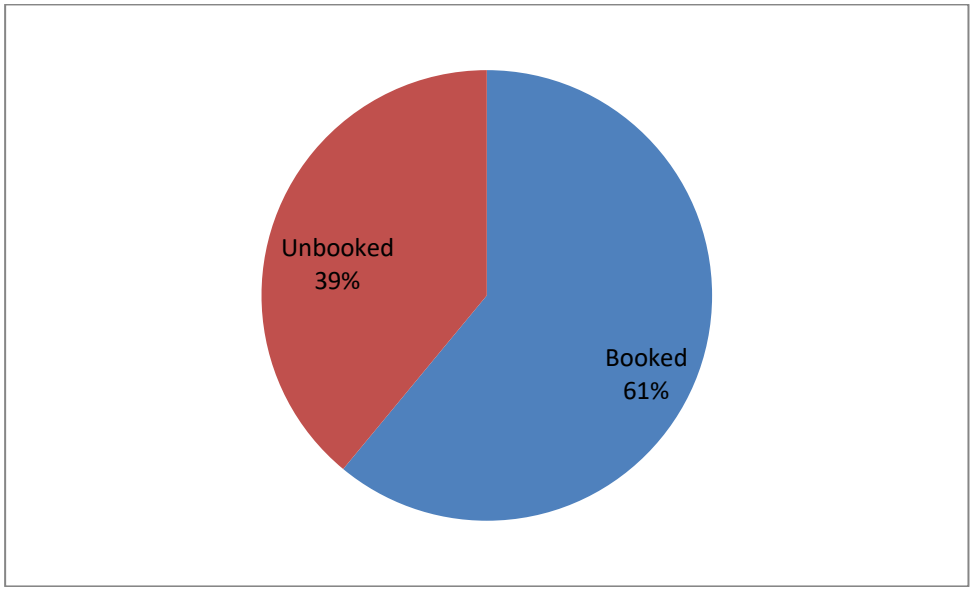

Fig 1: Booking status of patients

Diagram 1 shows the booking status of our patients. 61% (n = 67) of the patients were booked and 39% (n = 43) unbooked.

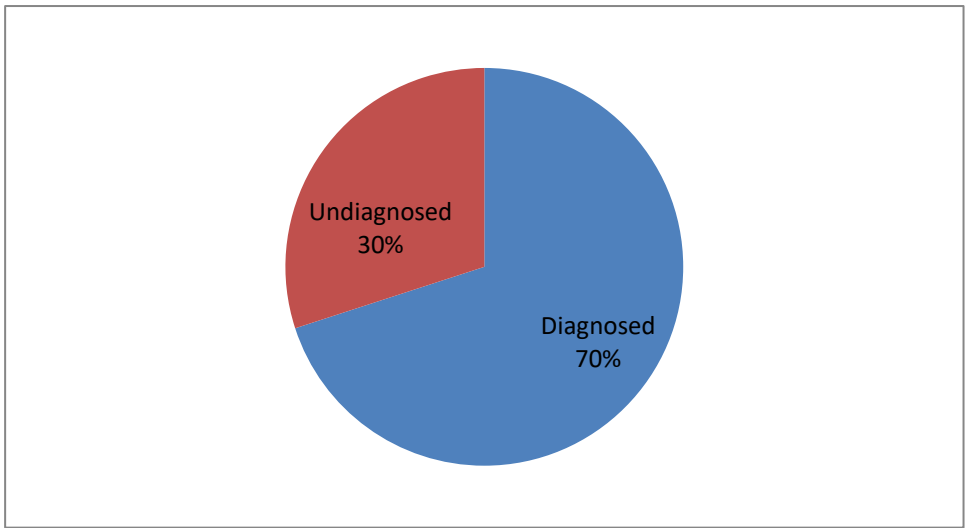

Fig 2: Number of cases diagnosed prior to pregnancy

Diagram 2 shows the number of cases diagnosed before pregnancy. About 30% (n = 33) were unaware of their cardiac problem prior to current pregnancy whereas 70% (n = 77) of patients were already diagnosed and aware prior to pregnancy.

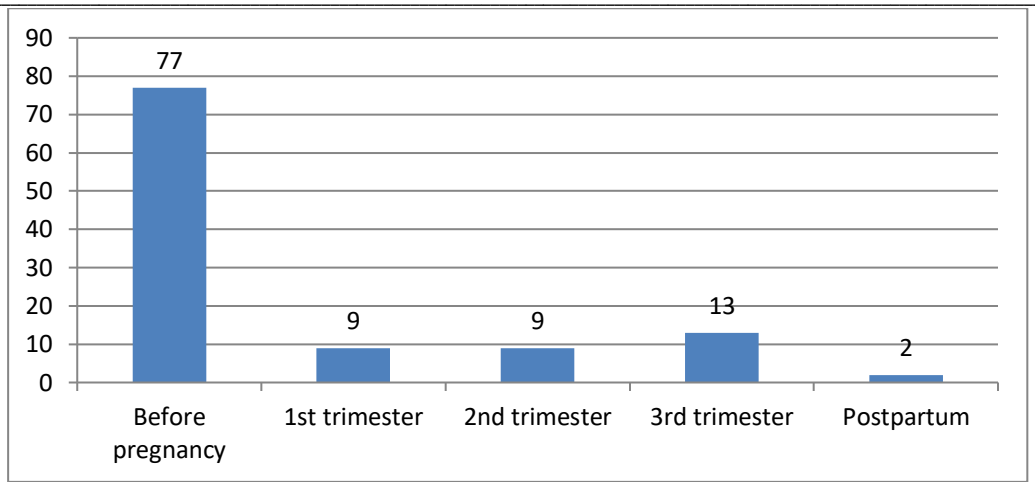

Fig 3: Time of first diagnosis of heart disease

Diagram 3 gives us a detailed insight about the time of first diagnosis of heart disease in our study subjects. 70% (n = 77) of cases were diagnosed before pregnancy. Among 30% (n = 33)of patients who were undiagnosed before pregnancy, 27.2% (n = 9) were diagnosed in 1st trimester, 27.2% (n = 9) in 2nd trimester, 39.3% (n = 13) in 3rd trimester and 6% (n = 2) patients were diagnosed in postpartum period.

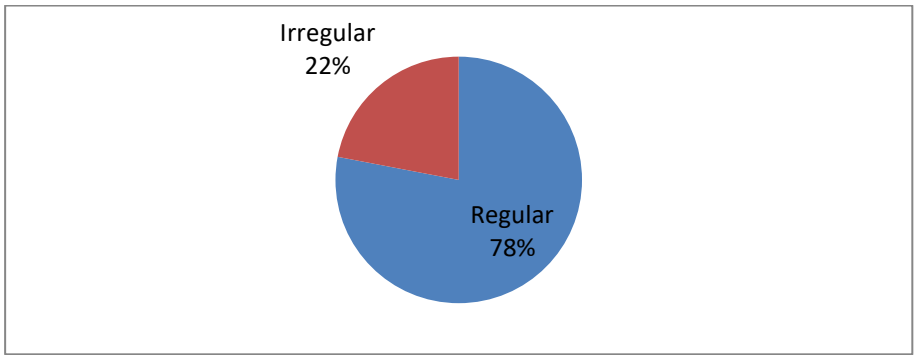

Fig 4: Medical care in the diagnosed

Diagram 4 describes about the diagnosed patients who were on treatment and follow up after diagnosis and/or surgery for cardiac disease. 78% of patients (n = 60) followed regular follow up and care whereas 20% of them (n = 17) were receiving either irregular follow up and care or no treatment.

Table 3: Age wise distribution of cases

Age group (in years)	No of cases	Percentage	Mean ± SD
18-20	13	11.81 %	26.45 ± 2.83 yrs
21-25	43	39.09 %	
26-30	37	33.63 %	
31-35	14	12.72 %	
>36	3	2.72 %	

Table 3 shows the distribution of cases according to age. There were 11.81% cases below 20 years, 39.09% cases between 21-25 years, 33.63% cases in 26-30 years range, 12.72% cases between 31-35 years age group and only 2.72% above 36 years of age. The mean maternal age at presentation was 26.45 ± 2.83 yrs.

Table 4: Parity wise distribution of cases

Gravida	No of cases	Percentage
G1	47	42.72%
G2-G4	54	49.09%
>G5	9	8.18%

Table 4 shows the distribution of cases parity wise. 42.72% were primigravida, 49.09% were gravida 2-4 and 8.18% were grand multigravida.

Table 5: Gestational age at the time of admission

Gestational age at the time of admission	No of cases	Percentage	Mean ± SD
>37weeks	76	69.09%	38.22 ± 5.164 weeks
34weeks -36weeks 6days	13	11.81%	
21weeks -33weeks 6days	7	6.36%	
<20weeks	14	12.72%	

Table 5 gives an idea about the distribution of cases with respect to the gestational age at the time of admission. Majority of them achieved term gestation by the time they required hospital services (69.09%).

The next major group consisted of 12.72% (n = 14) of patients, who required hospital admission before 20 weeks of gestational age due to various reasons, the prime one being severe degree of cardiac disease requiring termination of pregnancy. The mean gestational age at the time of admission was found out to be 38.22 ± 5.164 weeks.

Table 6: Type of heart disease

Type of heart disease	No of cases	Percentage
Rheumatic	50	45.45 %
Congenital	35	31.81 %
Mitral valve prolapse	10	9.09 %
Cardiomyopathies	8	7.27 %
Rheumatic superimposing on congenital heart disease	3	2.72 %
Arrhythmias	3	2.72 %
Dissecting aneurysm of aorta	1	0.90 %

Table 6 shows the type of heart disease in pregnancy encountered during the present study. 50 cases which presented were of rheumatic etiology, comprising 45.45%, out of which 29 cases had already undergone prior surgical correction.

Congenital heart disease patients comprised up to 32% of the sample size, which included both unrepaired and surgically repaired cases. There were 10 cases of mitral valve prolapse that were encountered during the study.

Out of the 8 patients having cardiomyopathy, 3 cases were of dilated type, 4 cases were of peripartum type and 1 case was of constrictive type.

There was a case of ventricular ectopic, a case of first degree heart block and a case of stable paroxysmal supraventricular tachycardia that were seen in the study period.

There was also a case of Marfan syndrome with dissecting aneurysm of aorta which got admitted during this time frame, which eventually underwent definitive surgical correction, i.e, Bentall procedure in immediate puerperal period.

Table 7: Rheumatic heart disease

	No of cases	Percentage
UNCORRECTED	**21**	**39.62 %**
MS only	2	3.77 %
MR only	2	3.77 %
MS with MR	5	9.43 %
MR with TR	3	5.66 %
Multivalvular lesions	9	16.98 %
CORRECTED	**32**	**60.37 %**
S/P PTMC	16	30.18 %
S/P valve repair	6	11.32 %
S/P valve replacement	10	18.86 %

Table 7 shows the distribution of cases having rheumatic heart disease, which includes both rheumatic and rheumatic superimposing on congenital heart disease.Multivalvular lesions involving mostly mitral and aortic valves, having both stenotic and regurgitant variety, represent the maximum number of uncorrected rheumatic lesions, followed by cases with combined mitral stenosis with mitral regurgitation.Out of 16 cases that had undergone PTMC, 11 of them were done before pregnancy while 5 of them had undergone the procedure during the current pregnancy.There were 3 cases of mitral valve repair and 3 cases of mitral along with tricuspid valve repair.Out of 10 cases of valve replacements, 7 were mitral valve replacements and the rest 3 cases were aortic valve replacements.

Table 8: Congenital heart disease

Type of lesion	No of cases	Percentage
Atrial septal defect	12 (repaired-6)	31.57%
Ventricular septal defect	6 (repaired-4)	15.78 %
Patent ductus arteriosus	6 (repaired-1)	15.78 %
Double outlet right ventricle	2 (repaired-2)	5.26 %
Transposition of great arteries	2 (repaired-2)	5.26 %
Bicuspid aortic valve	2 (repaired-1)	5.26 %
Ebsteins anomaly	2 (unrepaired)	5.26 %
Coarctation of aorta	2 (unrepaired)	5.26 %
Tetralogy of fallot	1 (unrepaired)	2.63 %
Pulmonary stenosis	1 (unrepaired)	2.63 %
Double chamber right ventricle	1 (unrepaired)	2.63 %
Dextrocardia	1 (unrepaired)	2.63 %

Table 8 shows the distribution of types of congenital heart disease, which includes both patients with congenital heart disease and those with rheumatic superimposing on congenital heart disease.Majority were cases of atrial septal defect comprising up to 32%, which included both uncorrected and corrected cases, followed by cases with ventricular septal defect (15.7%) and patent ductusarteriosus (15.7%).

Table 9: Pulmonary hypertension

Type	Cause	Degree of pulmonary hypertension		
		Mild	Moderate	Severe
PRIMARY		0	0	0
SECONDARY	Rheumatic	15	7	2
	Congenital	10	4	5
	Cardiomyopathies	1	4	0

S/P PTE		0	0	0

Pulmonary hypertension is an important sequelae associated with various types of heart disease. Table 9 shows the occurrence of this major prognostic factor among 110 subjects of our study.

There was neither a case of idiopathic pulmonary hypertension nor a case which had undergone pulmonary thromboendarterectomy (PTE) who was pregnant during the study period, although our institution is a centre of excellence for pulmonary thromboendarterectomy (PTE) and we have managed such pregnancies before and after our study period.

46 out of 110 patients (upto 42%) were found to have developed pulmonary hypertension secondary to long-term rheumatic and congenital heart disease. On the brighter side only a minor proportion of these admitted cases (n = 7) had severe degree of pulmonary hypertension.

Patients who had severe pulmonary hypertension were counselled by multidisciplinary team to undergo early termination of pregnancy. As they were managed on an outpatient basis, they were not counted in the statistics of our study.

But few patients inspite of counselling wanted to take forward the pregnancy by accepting the involved risks. These patients eventually became a part of the study.

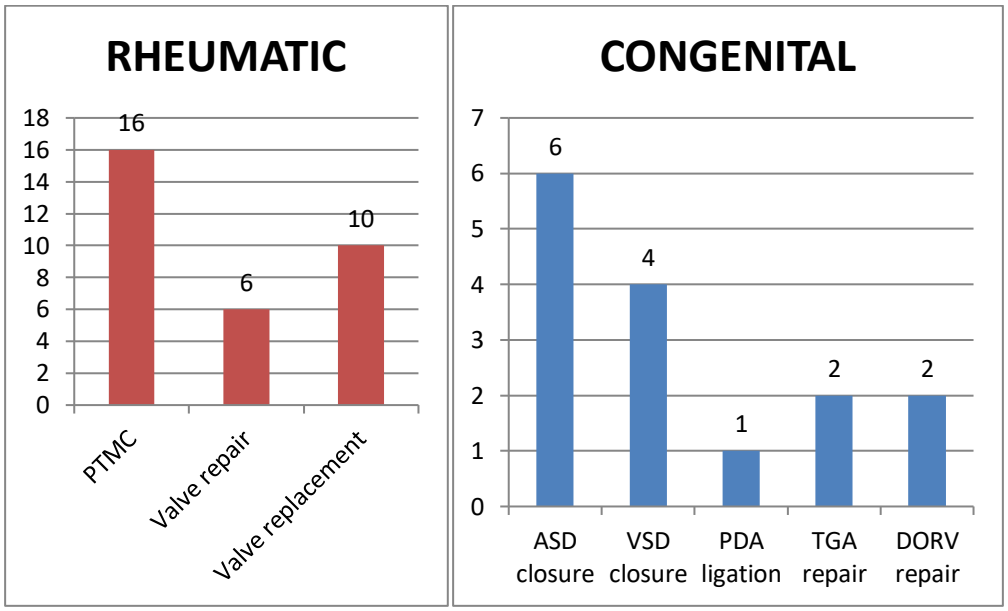

Diagram 15 (a) **Diagram 15 (b)**

Fig 5: Distribution of surgically treated patients

Among patients with RHD, 5 cases got benefitted from PTMC during current pregnancy of which 1 had undergone the procedure in 3rd trimester. There were 11 cases who underwent PTMC prior to current pregnancy of which 7 developed restenoses but none required repeat intervention.

There were 3 cases of mitral valve repair, 3 mitral with tricuspid valve repairs, 3 aortic valve replacements and 7 cases of mitral valve replacements. Only mechanical prostheses were used for AVRs whereas both mechanical (n = 5) and bioprosthetic (n = 2) valves were used in replacement of mitral valve.

Among pregnant women with CHD who had undergone prior surgical correction, ASD closure and VSD closure were the most frequently encountered procedures.

Table 10: Case distribution based on nyha functional class

NYHA class	No of cases	Percentage
I	57	51.81%
II	32	29.09%
III	13	11.81%
IV	8	6.36%

Table 10 and diagram 16 show the different classes of breathlessness due to cardiac origin, when patients first presented to our hospital. 51.81% were in functional class I, 29.09% in class II, 11.81% and 6.36% in classes III and IV respectively.

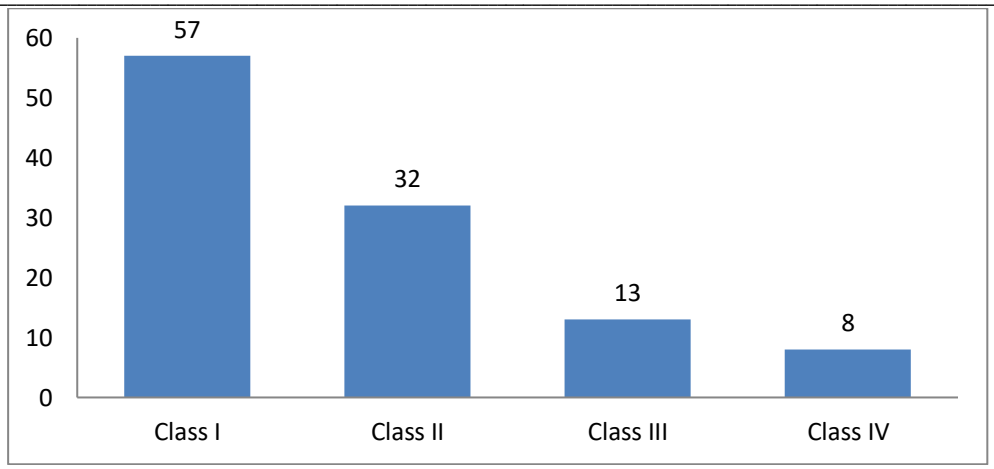

Fig 6: Case distribution based on nyha functional class

Table 11: Age wise distribution in relation with NYHA class

Age group (in years)	Class I	Class II	Class III	Class IV
18-20	7	5	1	0
21-25	20	15	4	4
26-30	20	9	5	3
31-35	8	2	3	1
>35	2	1	0	0

Tables 11 and 12 show the age wise and parity wise distribution of cases respectively, in relation to the grade of failure

Table 12: Parity wise distribution in relation with NYHA class

Gravida	Class I	Class II	Class III	Class IV
G1	19	19	5	4
G2	17	7	2	3
G3	12	3	2	0
G4	5	1	2	0
>G5	4	2	2	1

Table 13: Relationship of duration of hospital stay with NYHA class

Days of stay	Class I	Class II	Class III	Class IV
<5	53	22	3	3
6-10	4	9	8	1
11-15	0	1	2	3
>15	0	0	0	1

Table 13 shows the relationship of duration of hospital stay with NYHA functional class. There is an overall increase in the days of hospital stay with those patients having dyspnoea of classes III and IV.

Table 14: Relationship of maternal deaths with NYHA class

NYHA Class	No of cases	Deaths
I	57	0
II	32	0
III	13	0
IV	8	4

Table 14 shows the relationship of maternal deaths with NYHA functional class. All 4 deaths that occurred were in the patients belonging to class IV group. The duration of hospital stay in those particular cases are 1 day, 2 days, 4 days and 11 days respectively.

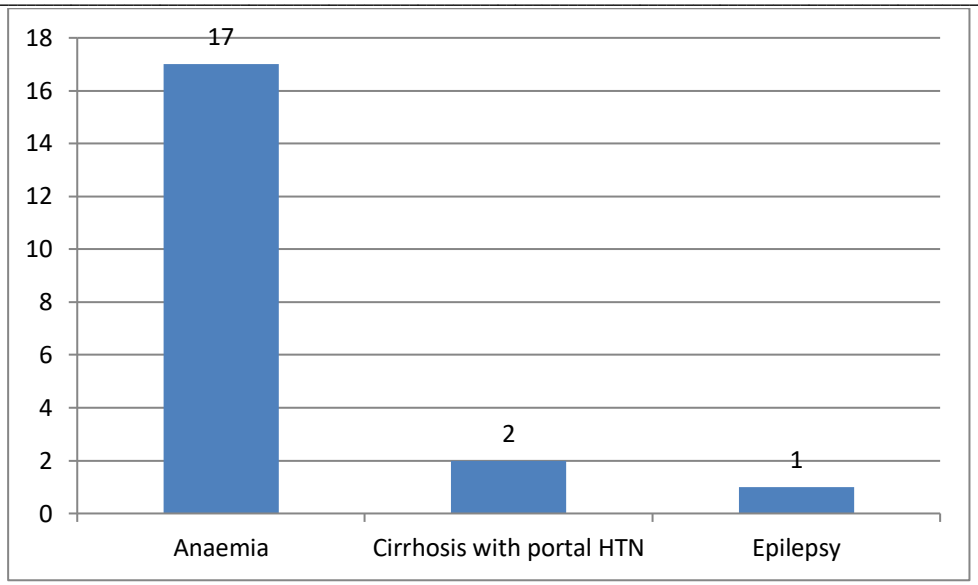

Fig 7: Medical comorbidities in women with heart disease

Diagram 7 shows the comorbid medical conditions that were frequently encountered in these group of patients, with the commonest being anaemia.

Table 15: High risk obstetric factors

Obstetric conditions	No of cases	Percentage
Preterm deliveries	19	17.27 %
PROM	16	14.54 %
Post caesarean pregnancy	14	12.72 %
IUGR	8	7.27 %
PIH	3	2.72 %
Breech	2	1.81 %
Twin pregnancy	1	0.90 %
Antepartum haemorrhage	1	0.90 %
Intrauterine death	1	0.90 %
Gestational diabetes mellitus	1	0.90 %
Traumatic postpartum haemorrhage	1	0.90 %

Table 15 give a brief description of high risk obstetric factors that were encountered in patients with heart disease. The most frequently observed high risk factor was preterm delivery, comprising 17.27%. The other common high risk factors that were seen are PROM, post caesarean pregnancy and IUGR. But there was no maternal death that occurred in any of the patients solely as a result of high risk obstetric factors.

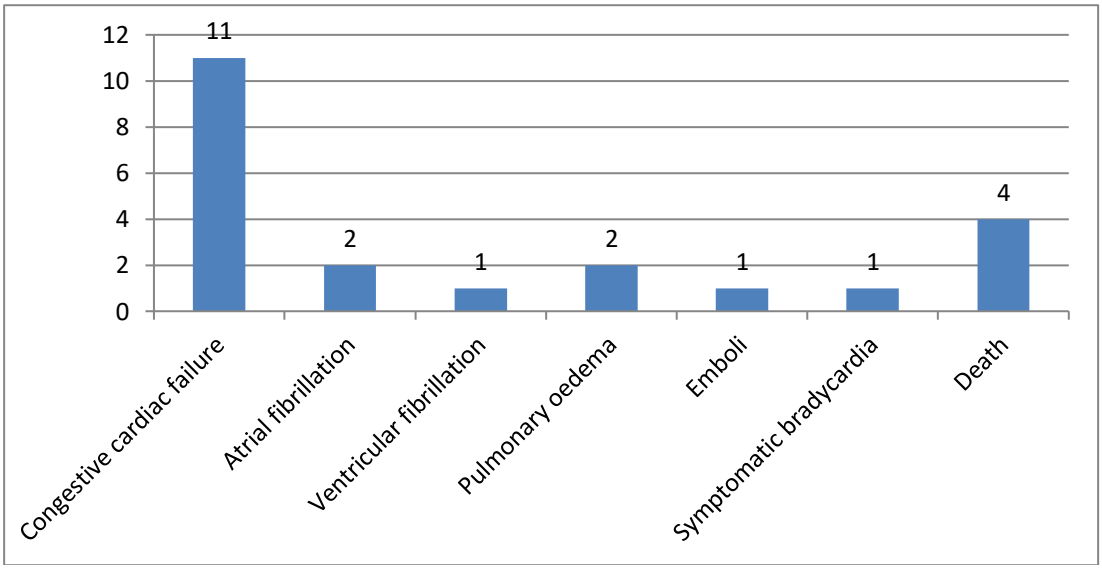

Fig 8: Cardiac complications

Diagram 8 enumerates the cardiac complications that were encountered in these patients. A total of 11 patients, comprising up to 10% of the study group, developed congestive cardiac failure, which was the most frequently observed cardiac complication.
There were 2 instances each of atrial fibrillation and frank pulmonary oedema and 1 instance each of ventricular fibrillation and multiple systemic emboli.
Symptomatic bradycardia developed in a patient with first degree heart block, which required temporary pacing for a period of 36 hrs.
There were 4 maternal deaths that were observed in total during the study period.

Table 16: Mode of delivery (n = 96)

Mode of delivery	No of cases	Percentage
Vaginal delivery	39	40.62%
Caesarean section	57	59.37%

Table 22and diagram 20 show the distribution of mode of delivery in the study group. More than half of them had undergone caesarean section due to various reasons discussed below.

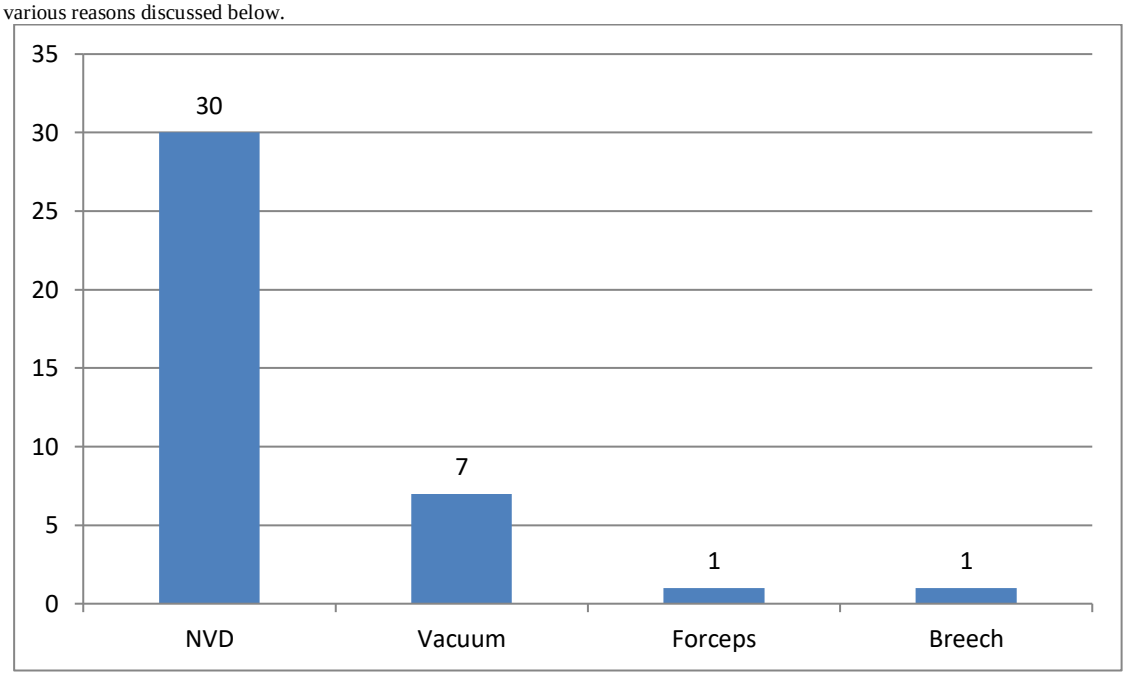

Fig 9: Vaginal delivery

Diagram 9 further details about the type and nature of vaginal delivery performed in study subjects.
Out of 30 cases which delivered normally through vaginal route, 6 were preterm deliveries and 1 case had shoulder dystocia following which the baby had persistently low APGAR score requiring NICU admission and eventually died after 7 days of intensive care.
Out of the 8 assisted vaginal deliveries, vacuum was used in 7 cases and outlet forceps delivery was performed in a case.

Table 17: Indications for caesarean section

Total no of caesarean sections (57)			
Emergency (38)		**Elective (19)**	
Fetal distress	14	Breech	2
Congestive cardiac failure	6	Dissecting aneurysm of aorta	1
Failed induction	3	Coarctation of aorta with bicuspid aortic valve	1
Previous LSCS with mobile head	3	Maternal request	3
Previous LSCS with scar tenderness	2	Previous LSCS with mobile head	9
Non progression of labour with PROM	3	Severe aortic stenosis	2
Cirrhosis with portal hypertension with hyperspenism	1	Transverse lie	1
Patient on warfarin with high INR with PROM	1		
Severe oligohydramnios	1		
Placenta praevia	1		
Eclampsia	1		
Transverse lie	1		
CPD	1		

Table 23 enumerates the various indications for which these cases had undergone caesarean section, the most common indication being fetal distress thus necessitating an emergency scenario.
A total of 7 cases underwent MTP, out of which 4 were done because pregnancy was a contraindication in view of their cardiac ailment, 2 were done because there was contraceptive failure and 1 was done because the fetus developed warfarin embryopathy. Of the 7 MTP, 5 were done before 12 weeks, 3 were done between 12 to 20 weeks.

Based on time of abortion, there were 10 abortions that took place in first trimester and rest 4 were second trimester abortions. Out of the 4 second trimester abortions, 2 were spontaneous abortions and 2 were medically terminated.

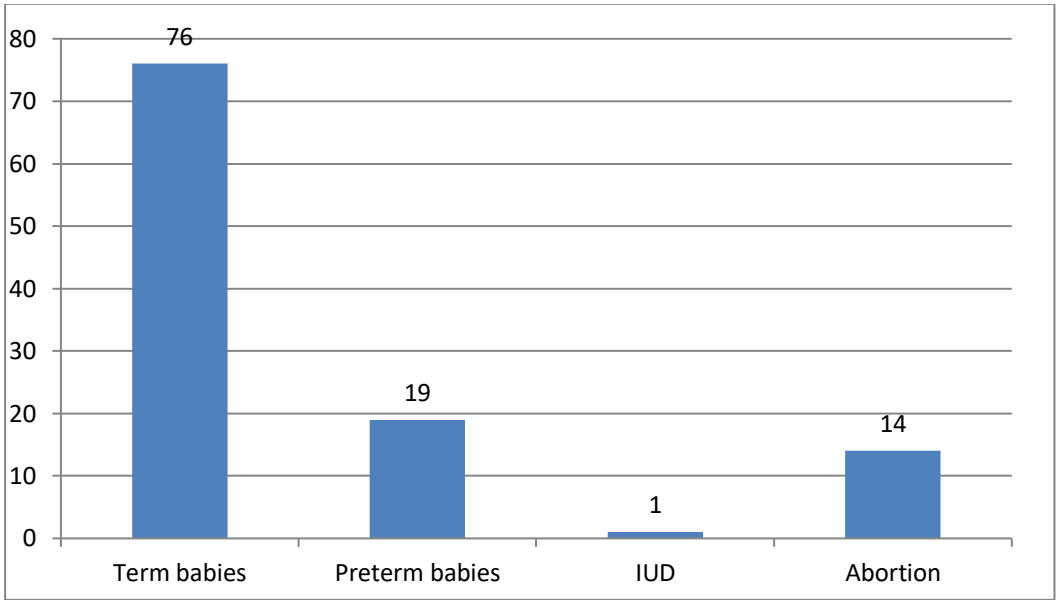

Fig 10: Fetal outcome observed with maternal heart disease

Diagram 10 and table 18 give an idea about fetal outcome in the 110 cases that were studied. 95 out of 110 patients (86.36%) had live births and majority of them were delivered at term gestation.

Table 18: Fetal outcome observed with maternal heart disease

Fetal outcome	No of cases	Percentage
Live births	95	86.36 %
Still birth	0	0
Intrauterine death	1	9.09 %
Abortions	14	12.72 %

Table 19: Birth weight of babies

Birth weight	No of cases	Percentage	Mean ± SD
<1 kg (ELBW)	2	2.06%	
1.01 – 1.50 kg (VLBW)	3	3.09%	
1.51 – 2.50 kg (LBW)	31	31.95%	
2.51 – 3 kg	40	41.23%	
> 3 kg	21	21.64%	2.54 ± 0.609 kgs

Table 19 shows the analysis of birth weight of babies. Majority of babies were delivered with normal birth weights (> 2.5 kg). There were 2 babies who were weighing less than 1 kg at birth. The mean birth weight was found out to be 2.54 ± 0.609 kgs.

Table 20: APGAR Score

Time (in minutes)	0	1-3	4-6	7-10
1	1	4	22	70
5	1	2	3	91

Table 20 shows the APGAR score distribution of babies. Most of them had good APGAR scores by the end of 5 minutes.

Table 21: Overall neonatal outcome

Neonatal outcome	No of cases	Percentage
Healthy	64	58.18 %
Low birth weight	36	32.72 %
Preterm babies	19	17.27 %
Babies with IUGR	8	7.27 %
Low APGAR score at 5 minutes	6	5.45 %
NICU admissions	31	28.18 %
Perinatal mortality	5	4.54 %

64 women had given birth to healthy babies who had no issues in the perinatal period, which comprise up to 58%. The most common issue that was encountered was low birth weight (33%) followed by preterm babies (17%). There were 31 NICU admissions in total (28%) out of which 4 babies could not survive. The other perinatal death was an intrauterine death.

Table 22: Statistical analysis showing significant risk factors for maternal and neonatal adverse events

Risk factors	P value
Maternal risk factors	
NYHA class III/IV at booking	**0.039**
Pulmonary hypertension	**0.002**
Mode of delivery	**0.698**
Neonatal risk factors	
NYHA class III/IV at booking	**0.034**
Presence of anaemia in mother	**0.045**

Table 22 gives us the statistical analysis showing various significant risk factors for maternal and neonatal adverse events.

After multivariate analysis, adjusting for the confounding variables, NYHA class at booking (p 0.039) and pulmonary hypertension (0.002) remained as independent risk factors for maternal adverse cardiac events whereas maternal characteristics such as mode of delivery (p 0.698) were not significantly associated with maternal complications.

After multivariate analysis for the adverse neonatal outcome, it was found that NYHA class at booking (0.034) and mother being anaemic in present pregnancy (0.045) were the risk factors for adverse neonatal outcome.

Discussion

Heart disease in pregnancy is a common problem across different parts of the world but more prevalent in developing countries. With the advent of more and more modern techniques and advancement in knowledge, the haemodynamic circulation in pregnancy is better understood and managed. The availability of echocardiography provides accurate information about disease etiology, and noninvasive assessment of severity and means of monitoring progression.

Incidence

This prospective observational study was conducted over a period of twenty two months, from November 2013 to September 2015. A total number of 110 cases of heart disease complicating pregnancy were admitted at Narayana Hrudayalaya Institute of Medical Sciences, Department of Obstetrics, Gynaecology and Reproductive Medicineat Bangalore during this period.

Incidence of heart disease among pregnant women in the present study was 3.06% which is on the higher side when compared with the studies done previously.

Table 23: Comparison of incidence with various studies

Author	Year	Incidence
Garg et al[14]	2014	0.60%
Chichawade et al[15]	2014	1.00 %
Nagamani et al[16]	2015	1.20%
Present series	2015	3.06%

Socio economic strata

In the present study, maximum distribution of cases is seen in socioeconomic class III (36.36%;). This finding contradicts the common notion and results stated in standard literature which showed correlation between poor socioeconomic strata (class IV and V) and cardiac disease (especially rheumatic).

Antenatal care

The proportion of booked cases (61%) was greater in comparison to unbooked cases (39%) in our study. We also observed that adverse maternal conditions like anaemia, PIH were more prevalent in the unbooked group, compared to booked group. This finding is similar to the studies of Bhatlaet al[17] and Elliot et al[18].

Age and parity of patient

The maximum number of patients in the present study belonged to 21-25 years group (39.09%), which is similar to the studies done by Bhatla et al[17] and Chinchawade et al[19]. The predominance in this early age group can probably be explained by the prevalence of early marriages in our country.

Period of gestation

In the present study, 69% of cases achieved term gestation while 17% of cases delivered prematurely. The remaining cases were abortions and an intrauterine death. Bhatlaet al[17] series reported 75% term deliveries and 23% premature deliveries.

Type of heart disease

Although the incidence of cardiac disease in pregnancy has remained unchanged across various parts of the world, the relative contribution of different etiologies of heart disease varies with the study population and also with changing times.Rheumatic heart disease (up to 46%) remained the most common etiology in our study followed by congenital heart disease (up to 32%), mitral valve prolapse (9%), cardiomyopathies (7%) and others comprised the remaining proportion ofcases.

Table 24: Comparison of cardiac etiologies with various studies

Author	Year	Rheumatic	Congenital	Others
Nagamani**[16]**	2015	40 %	23 %	37 %
Elliott**[18]**	2015	30 %	34 %	36 %
Present series	2015	46%	32%	22%

Rheumatic heart disease

Mitral valve was affected alone or in combination in nearly 90% of cases, comparable to the values given in various other studies. Greater magnitude of cases (60.37%) had already undergone some sort of invasive intervention prior to present pregnancy, most of them being PTMCs.

Congenital heart disease

The incidence of various congenital heart diseases in the study correlated with that of general female population. Atrial septal defect headed the list, with ventricular septal defect and patent ductusarteriosus coming second. A significant proportion of these cases had already undergone surgical correction by the time they reached reproductive age.

Pulmonary hypertension

Though it is not a separate entity per se (except for the primary/idiopathic type, which we did not encounter during our study period) it deserves a special mention here because of its existence in

significant proportion of long-standing cases of rheumatic and congenital heart disease.
Usually patients with severe pulmonary hypertension were counselled by multidisciplinary team to undergo early termination of pregnancy as it is proven contraindication[20].

Role of cardiac interventions
In patients with RHD, majority of women (60.37%) became pregnant after cardiac intervention. These statistics are comparable with most studies done in the last decade such as Bhatlaet al[17] and Koregol et al[8]. The number of women coming up for pregnancy with corrected lesions has steadily increased over the past few decades, which can be attributed to improved accessibility of healthcare facilities.

Grading of heart disease
In the present series maximum number of cases were detected in classes I and II, which was similar to other prominent studies. Though the patients with NYHA class III and IV were less in number, they had the worst maternal and perinatal outcomes.

Table 25: Comparison of nyha class distribution with various studies

Authors	Year	Class I	Class II	Class III	Class IV
Bhatla et al[17]	2003	52.61 %	27.5 %	14 %	26.9 %
Sayeeda et al[13]	2008	80 %	14 %	6 %	0
Garg et al[14]	2014	48 %	36 %	12 %	4 %
Present series	2015	51.81 %	29.09 %	11.81 %	6.36 %

Medical comorbidities
In the present series about 15% patients were found to be anaemic. Other comorbidities included 2 cirrhotic patients with portal hypertension and 1 known epileptic patient.

High risk obstetric factors
In the current series other than having cardiac disease, pregnancy was otherwise complicated by various obstetric risk factors such as preterm labour (17.27%), premature rupture of membranes (14.54%) and post caesarean pregnancy (12.72%) among others. None of these factors solely resulted in any of the maternal deaths during the study but they were found to increase both maternal and perinatal morbidity to some extent.
As compared to other studies such as Bhatlaet al[17] which showed a significant number of cases with pregnancy induced hypertension (21%), there were only 3 patients that we encountered in our study who developed PIH in a setting of heart disease.

Cardiac complications
The cardiac complications that occurred in our study, were summarised and compared with various recent studies. The results were more comparable with results of Koregolet al[8].

Table 26. Cardiac complications

Complication	Abdel Hady[101]	Sayeeda[13]	Koregol[8]	Garg[14]	Present series
CCF	16.43 %	24 %	14.28 %	32 %	10.00 %
Atrial fibrillation	5.32 %	12 %	3.42 %	8 %	1.81 %
Pulmonary oedema	3.63 %	6 %	2.54 %	24 %	1.81 %
Emboli	2.62 %	3 %	1.1 %	8 %	0.86 %
Maternal death	6.84 %	8 %	6.82 %	20 %	3.63 %

Mode of delivery
At our hospital mode of delivery was decided based on obstetric indication and cardiac assessment of the patient. The incidence of caesarean delivery in this study, increased steadily from 49% in functional class I to 100% in class IV. The results from our study matched to greater extent with studies done by Abdel Hadyet al[21].

Abortions
There were 14 abortions reported in our study (12.72%), similar to that of Sheela et al[22]. Out of these, 4 were 1st trimester missed abortions, 3 were spontaneous miscarriages and the rest were terminated using medical method. Most of them underwent medical termination of pregnancy because pregnancy was contraindicated in view of their cardiac ailment.

Neonatal outcome observed with maternal heart disease
In this study, majority of babies were born healthy and were delivered after reaching term gestation (69.09%;.We reported 95 live births (86.36%), 1 intrauterine death (0.90%) and 14 abortions (12.72%) from our study. In comparison Bhatlaet al[17] reported 91% live births and 5.4% still births. Elliott et al[18] reported 90% live births and 3.2% still births.
Most of the neonates were weighing more than 2.5 kg at birth (63 %;) and had good APGAR scores at 1 and 5 minutes after birth, comparable with those in the general population. Low birth weight newborns (56.41% vs. 33.33%) were more in patients belonging to NYHA III and IV functional class, probably due to factors such as maternal haemodynamic compromise, placental insufficiency and exposure to drugs such as diuretics, digitalis and beta blockers.

Perinatal mortality
Out of the 5 perinatal deaths that occurred in the study period, there were 3 preterm babies among which one was born with multiple congenital anomalies. There was a term baby that died due to birth asphyxia as a result of shoulder dystocia. Also there was an intrauterine death which was probably due to hypoxia as mother had CCF with AF.

Maternal mortality
There were 4 maternal deaths observed in our study. 2 among them were due to peripartum cardiomyopathy, one had severe grade of rheumatic heart disease and the other congenital heart defect. All 4 of them developed NYHA class IV breathlessness before succumbing to death.
Many maternal deaths due to pre-existing heart disease can be prevented by early detection and considering the possibility of surgical correction prior to pregnancy, proper pre-pregnancy counselling, efficient antenatal care and multidisciplinary team approach.

Conclusion
Heart disease continues to be a major indirect cause of maternal death. The likelihood of a favourable fetomaternal outcome depends on

- Age, education and socioeconomic background.
- Early detection and treatment of cardiac condition prior to conception.
- Functional cardiac capacity.
- Other complications that further increases the cardiac workload.
- Quality of multidisciplinary care provided.

"A pregnant woman is like a ship on a stormy sea and good captain must guide her with prudence if she is to avoid a shipwreck."

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