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Original Article

Neonatology Section

Outcome of Newborns Born to Mothers with Heart Disease by Operative Mode of Delivery – A Study from South India

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ABSTRACT

Context: Heart disease complicates approximately 1% of all pregnancies. Maternal cardiac disease in pregnancy has a bearing on pregnancy course and neonatal outcomes. Indian studies in this regard are sparse and moreover were undertaken mostly by obstetricians.

Aims: The present study was planned looking from a paediatrician's perspective in order to study all possible neonatal outcomes born to mothers with heart disease delivered by operative mode.

Settings & Design: The data consisted of retrospective (old patient records with obstetric and cardiac details including echocardiography reports) and prospective data (monitored from the first antenatal visit to the delivery regularly by obstetricians and cardiologists) conducted in a multispeciality hospital including a tertiary care cardiac centre.

Materials and Methods: Pregnant women with Congenital Heart Disease and Rheumatic Heart Disease and their newborns born by caesarean section were enrolled from 2006 - 2010. These women were treated according to their New York Heart Association (NYHA) class to improve their cardiac status. The neonatal group was followed for certain events (outcome) from delivery till discharge. These outcomes were compared between the test group (mothers with cardiac risk factors, unoperated mothers and those without drugs) and the control groups (mothers with no cardiac risk factors, operated mothers and those on drugs).

Statistical Analysis used: SPSS v 17 software was used for statistical analysis. Descriptive analysis, Chi Square test and multiple logistic regression were used. Statistical level of significance was fixed at $p < 0.05$.

Results: 55 pregnant women with heart disease and their 55 newborns were seen. Neonatal outcome was adverse in 58% babies; 47% were born to mothers with cardiac risk factors. 25 newborns (45%) had low birth weight, 15 (27%) were preterm, 20 (36%) had jaundice. 18 (33%) were small for gestational age, 8 babies (15%) had congenital anomalies (cardiac - 7; non cardiac – 3). 21% of babies with CHD were born to mothers with CHD. There were 2 neonatal deaths (4%). Statistically significant outcome was found with respect to prematurity only. 33% mothers had one or more of the 5 cardiac risk factors. There was no difference in neonatal outcomes between mothers with RHD or CHD.

Conclusion: The outcome of newborns is influenced by maternal cardiac risk factors. There were no differences in neonatal outcomes born to mothers with RHD and CHD and mothers with operated and unoperated heart disease.

Keywords: Co-morbidities, Cardiac risk factors, Maternal heart disease, Neonatal outcomes, Prematurity

INTRODUCTION

Heart disease complicates approximately 1% of all pregnancies. Rheumatic Heart Disease is more common in developing countries. Maternal cardiac disease in pregnancy has a bearing on the course of the pregnancy and therefore the neonatal outcome [1-5].

The outcome in the present era is much brighter compared to earlier decades because of the advances in cardiology and increasing health awareness which have paved the way for increased survival of women with congenital heart defect to reproductive age [6,7].

Indian studies looking into this aspect are far and few and moreover almost all studies have been undertaken by obstetricians who have not looked in detail into the neonatal outcome [8-10]. The present study was conducted at a referral cardiac centre with good

Description of co-morbidities	Preterm AGA	Preterm SGA
Central Nervous System	Altered sensorium	2 (4)
	Seizures	3 (5)
	Intra cranial bleed	1 (2)
Respiratory System	RDS	3 (5)
	TTNB	1 (2)
	Pneumonia	1 (2)
	Sepsis	1 (2)
Cardio Vascular System	Hypotension	3 (5)
	Tachycardia	4 (7)
	CHD	7 (13)
Gastro Intestinal System	Feed intolerance	4 (7)
	NEC	1 (2)
Renal	ARF	1 (2)
Eye	Cataract	1 (2)
	ROP	1 (2)
Hematological	Anemia	1 (2)
	Polycythemia	3 (5)
	Thrombopenia	3 (5)
	Leukocytosis	5 (9)
	Leukopenia	1 (2)
	Jaundice	20 (36)
Metabolic	Hypoglycemia	7 (13)
	Hypocalcemia	5 (9)
	Hypomagnesaemia	2 (4)
	Metabolic acidosis	5 (9)
Immunological	Sepsis	3 (5)
Temperature	Hypothermia	4 (7)
	Hyperthermia	0
Congenital anomalies	Cardiac	7 (13)
	Non Cardiac	3 (5)

[Table/Fig-1]: Description of co-morbidities
• ROP - Retinopathy Of Prematurity, RDS - Respiratory Distress Syndrome, TTNB -Transient Tachypnoea of New Born, CHD - Congenital Heart Disease, NEC - Necrotising Entero Colitis, ARF - Acute Renal Failure
• Numbers in brackets are percentages calculated for total 55

obstetric and neonatal back up and hence this is relevant here due to many pregnant women with cardiac complications following up regularly. Owing to the same reason, the study population is a heterogeneous one with cases comprising of mothers with low risk cardiac disease, mothers with high risk cardiac disease under control by drugs or surgery or mothers with irreparable cardiac disease.

Hence, in this study of outcomes of newborns born to mothers with cardiac disease, we have attempted to look at a paediatrician's perspective rather than an obstetrician's view point, studying all possible neonatal outcomes.

Congenital anomalies (n=8) including CHDs	Type of anomaly in baby	Type of anomaly in mother	Number of cases (n = 8)
Cardiac (n = 7)	ASD with PDA	CoA repair VSD closure	1 (2)
	Dextrocardia VSD	Mitral valve replacement	1 (2)
	ASD + VSD + PDA	Mitral valve repair	1 (2)
	PDA	CoA repair with VSD closure	1 (2)
	VSD	Truncus repair with VSD closure	1 (2)
	PDA with ASD	Complete AVSD with ASD with VSD with TGA with PS	1 (2)
	CoA with PDA	PDA with Eisenmenger's disease	1 (2)
Non Cardiac (n = 3)	Posterior Urethral Valves	MS MR AR	1 (2)
	Ambiguous Genitalia	PDA Eisenmenger's disease	1 (2)
	Congenital Cataract	Truncus repair VSD	1 (2)

[Table/Fig-2]: Distribution of congenital anomalies including CHD • *ASD - Atrial Septal Defect VSD - Ventricular Septal Defect PDA - Patent Ductus Arteriosus CoA - Coarctation of Aorta AVSD - Atrio - Ventricular Septal Defect TGA - Transposition of Great Arteries PS - Pulmonary Stenosis MS - Mitral Stenosis MR - Mitral Regurgitation AR - Aortic Regurgitation*
• Numbers in brackets are percentages calculated for total 55

MATERIALS AND METHODS

The present study is a descriptive study consisting of retrospective and prospective data. It was conducted in a multispeciality hospital that included a cardiac centre too. The inclusion criteria consisted of pregnant women with heart disease (Congenital Heart Disease and Rheumatic Heart Disease) enrolled at Narayana Multispeciality Hospital in Bangalore from 2006 to 2010 and their newborns who were all born by operative mode of delivery. Those with isolated conduction defects and cardiomyopathies were not included. The study received institutional ethics committee approval. Informed consent was obtained from patients before data collection. Investigations were carried out as per the hospital protocol. The retrospective study design consisted of old patient records with obstetric and cardiac details including echocardiography reports. Prospectively each pregnant woman was monitored from the first antenatal visit to the delivery regularly by obstetricians and cardiologists. It was mainly a cross sectional study of the neonates with examination just after birth.

Major Neonatal Outcomes	Number of cases in CHD mothers (n = 24)	Number of cases in RHD mothers (n = 31)	p value
Prematurity	11 (46)	4 (13)	0.01
LBW	11 (46)	14 (45)	0.58
IUGR	7 (29)	11 (35)	0.77
Jaundice	9 (38)	11 (35)	0.43
Congenital Anomalies including CHD	5 (21)	3 (10)	0.24
CHD	5 (21)	2 (6)	0.22
Neonatal Death	2 (8)	0	0.18
Maternal Death	2 (8)	0	0.07

[Table/Fig-3]: Neonatal and maternal outcomes in mothers with RHD and CHD
• *Numbers in brackets are calculated for their respective n*

Major Outcomes	Number of cases in Unoperated mothers (n = 27)	Number of cases in Operated mothers (n = 28)	p value
Prematurity	10 (37)	5 (18)	0.09
LBW	12 (44)	13 (46)	0.54
IUGR	7 (26)	11 (39)	0.22
Jaundice	8 (30)	12 (43)	0.35
Congenital anomalies including CHD	3 (11)	5 (18)	0.37
CHD	2 (7)	5 (18)	0.22
Neonatal Death	1 (4)	1 (4)	1.0
Maternal Death	1 (4)	1 (4)	0.48

[Table/Fig-4]: Neonatal and maternal outcomes in mothers with unoperated and operated heart disease

All RHD mothers were given regular penicillin prophylaxis. Cardiac surgeries were undertaken wherever indicated and feasible.

The following baseline characteristics were noted in all pregnant women: age, parity, weight, antenatal booking status, bad obstetric history (BOH), type of cardiac lesion, presence or absence of cardiac risk factors like prior cardiac events like stroke, arrhythmias, failure, presence of cyanosis, NYHA 3/4, severe outflow tract obstruction like area of mitral valve less than 2 cm^2, aortic valve less than 1.5 cm^2 and left ventricular peak outflow gradient of more than 30 mm Hg, severe myocardial dysfunction like left ventricular ejection fraction (LVEF) < 40%, original cardiac status including echocardiography findings (fetal echocardiography was done for those mothers with CHD and those on anticoagulation which was concordant with neonatal echocardiography), cardiac status at pregnancy, use of cardiac medications, cardiac surgeries, complications during pregnancy, presence of obstetric risk factors like pregnancy induced hypertension, premature rupture of membranes, malpositions, hypothyroidism, oligohydramnios etc.,

Major outcomes	Number of cases in those born to Cardiac risk mothers (n = 18)	Number of cases in those not born to Cardiac risk mothers (n =37)	p value
Prematurity	10 (56)	5 (14)	0.003
LBW	14 (78)	11 (30)	0.001
IUGR	11 (61)	7 (19)	0.003
Jaundice	10 (56)	10 (27)	0.06
Congenital anomalies including CHD	5 (28)	3 (8)	0.06
CHD	4 (22)	3 (8)	0.14
Neonatal Death	1 (6)	1 (3)	0.61
Maternal Death	1 (6)	1 (3)	0.03

[Table/Fig-5]: Neonatal and maternal outcomes in mothers with and without cardiac risk factors.

mode of anaesthesia, and genetic counseling if sought (for bad obstetric history) and outcome of mothers in the form of survival or death.

The neonatal events were observed in the form of APGAR scores, birth weight using CDC charts, gestational age using New Ballard scoring, neonatal deaths, co-morbidities like jaundice, respiratory distress, metabolic disturbances, feed intolerance, seizures, sepsis, polycythemia, congenital anomalies including CHD for which echocardiography was done on all babies born to mothers with CHDs, requirement of CPAP / ventilator etc.

Adverse neonatal events were Low Birth Weight (Extremely Low Birth Weight and Very Low Birth Weight included), Prematurity, Small for Gestational Age, Large for Gestational Age, Neonatal Deaths, Co-morbidities like Jaundice, Congenital Anomalies, CHDs, Respiratory Distress, etc. These neonatal outcomes were compared between groups of newborns born to mothers with and without cardiac risk factors, born to mothers with RHD and CHD, born to mothers with operated and unoperated heart disease and between those born to mothers with and without cardiac drugs.

SPSS v 17 software was used for statistical analysis. Descriptive analysis was used to summarise baseline characteristics of the study population using mean and standard deviation for continuous variables and proportion and percentage for ordinal variables. Chi Square test of proportion was used to assess the statistical significance of difference in proportions between the dependent neonatal outcomes and independent maternal risk factors. Multiple logistic regression was used to assess the relation between neonatal outcomes and maternal factors. Statistical level of significance was fixed at $p < 0.05$.

RESULTS

The study population consisted of 55 pregnant women with heart disease and their 55 newborns (singleton pregnancies) born by operative mode of delivery (caesarean section).

Among the 55 newborns, M:F = 25:30. 1 child had a birth weight < 1 kg; 2 had birth weight between 1.0 - 1.49 kg; 4 were in 1.5 - 1.99 kg group; 18 in 2.0 - 2.49 kg group and 30 weighed ≥ 2.5 kg at birth. 40 were born at term and 15 were preterm. Based on the gestational age, 40 were in 37 - 42 weeks range; 12 in 34 - 36 weeks; 2 in 31 - 33 weeks and 1 was in 28 – 30 weeks group.

NEONATAL PARAMETERS

Out of 55 babies, about 15 male babies (47%) and 17 female babies (53%) had adverse outcomes.

Maximum events were LBW (25 / 45%) followed by jaundice in 20 /36, IUGR in 18 / 33, prematurity in 15 / 27, congenital anomalies including CHD in 8 / 15, CHD in 7 / 13 and neonatal death in 2 /4. 25 babies (45%) had low birth weight out of which 1 was Extremely Low Birth Weight (ELBW) and 2 were Very Low Birth Weight (VLBW). 18 had intrauterine growth retardation (IUGR) (33%) of which 7 were preterm and 11 were term.

15 had prematurity (27%) of which 7 were small for gestational age (SGA) and 8 were appropriate for gestational age (AGA). Among the term babies, 11 were SGA and 29 were AGA. None were large for gestational age. So the maximum outcomes were term AGA (29 or 52%) followed by term SGA (11 or 20%) preterm AGA (8 or 15%) and preterm SGA (7 or 13%).

About 20 (36%) babies had jaundice, 8 (15%) had congenital anomalies including CHD, 7 (13%) had only CHDs and 13 (24%) had other co-morbidities as listed in [Table/Fig-1].

6 babies (11%) had poor APGAR scores requiring active resuscitation all in the form of bag and mask ventilation. 2 babies were depressed neurologically due to the effect of maternal general anaesthesia. These babies had APGAR scores of 4 - 6 requiring active resuscitation in the form of bag and mask ventilation but then quickly recovered. None required chest compressions or drugs. Of these 3 (5%) required mechanical ventilation.

Two babies died within the neonatal period (4%).

8 babies had congenital anomalies including CHD [Table/Fig-2]. 2 babies had both cardiac and non cardiac anomalies. Of the 7 neonatal CHDs, 5 were born to CHD mothers and 2 were born to RHD mothers of which 1 mother was on anticoagulation for valve replacement. 21 % babies born to mothers with CHDs had CHD.

MATERNAL PARAMETERS

Among the 55 women with heart diseases, 24 (44%) had CHD and the remaining 31 (56%) had RHD.

There were 24 cases of CHD of which the most common lesion overall was Atrial Septal Defect (25%). Out of the total 24 cases, 16 had acyanotic CHDs (6 had ASD; 4 - VSD; 1 - Cortriatrium with Aortic Regurgitation (AR); 1 - Marfan's disease; 4 - CoA Coarctation of Aorta) and 8 had cyanotic CHDs [3 had Ebstein's Anomaly; 1 - Truncus Arteriosus; 2 - PDA with Eisenmenger's Disease; 2 had Complex CHD ((i) VSD with sub aortic membrane with bicuspid aortic valve + moderate AR with severe outflow obstruction + parachute mitral valve (ii) Complex Atrioventricular canal defect + ASD + VSD + Transposition of Great Arteries + Severe Pulmonary Stenosis)]. ASD was the most common acyanotic heart disease seen in 6 whereas Ebstein's anomaly was the most common cyanotic heart disease seen in 3.

Out of 24 cases, 16 were unoperated and 8 cases were operated for their cardiac disease with the most common surgery being CoA angioplasty. Among the 16 unoperated cases, 2 each had PDA with Eisenmenger's disease, Ebstein's Anomaly with ASD and Complex Congenital Heart Disease respectively; 4 each had ASD and VSD respectively; 1 each had Cor triatrium with AR and dissecting aortic aneurysm with severe AR with Marfanoid features respectively. Among the 8 operated cases, 1 each had undergone Truncus Arteriosus repair and Ebstein's repair respectively; 2 had undergone ASD closure and 4 had undergone Coarctation of Aorta angioplasty with VSD closure.

Out of 31 cases of RHD, majority had univalvular lesions (65%) [Mitral valve in 18 and Aortic valve in 2] followed by bivalvular in 32% cases [Mitral + Aortic valves in 8 and Mitral + Tricuspid valves in 2] and multivalvular in 3% cases. The predominant lesion affected was Mitral regurgitation (MR) (60%). Mitral valve was the most common valve affected alone or in combination in 29 out of 31 cases or 94% mothers followed by aortic valve alone or in combination in 11 or 35% mothers. Tricuspid valve was affected in 3 or 10% mothers.

Among the 11 unoperated cases, 3 had MR + Mitral stenosis (MS); 2 had MS + MR + Aortic regurgitation (AR); 1 each had MR, MR + AR, MS + MR + Tricuspid regurgitation (TR), MS + MR + Aortic stenosis (AS) + AR, MS + MR + AR + TR, Mitral valve prolapse (MVP) + MR + TR respectively.

Out of the 31 cases, 20 (65%) were operated of which mitral valve replacement was the most common surgery in 8 patients. 6 patients had undergone mitral valve repair, 3 had undergone double valve replacement and one each had undergone aortic valve replacement (AVR), AVR + Mitral Valve Repair and Excision of aortic aneurysm + aortic valve repair respectively. Thus, out of the total 55 cases, 51% were operated within 5 years of delivery.

Most of the mothers underwent Caesarean section on general anaesthesia. The type of anaesthesia did not significantly influence the neonatal outcome. Two babies had poor APGAR scores because of maternal general anaesthesia requiring bag and mask ventilation but they recovered within 5 minutes.

NEONATAL OUTCOMES

On comparing the adverse neonatal outcomes in CHD and RHD, statistically significant outcome was found with respect to prematurity only whereas other outcomes were insignificant [Table/Fig-3].

No statistically significant difference was found in terms of bad neonatal / maternal outcome in operated and unoperated heart disease [Table/Fig-4]. Mothers who were operated had slightly higher incidence of LBW, IUGR, jaundice, congenital anomalies but none were statistically significant. The neonatal outcomes were similar in operated and unoperated CHDs and RHDs.

18 women (33%) had either one or more of the 5 cardiac risk factors (prior cardiac events, NYHA 3/4, cyanosis, severe myocardial dysfunction, severe valvular outflow obstruction). NYHA 3/4 was the most common risk factor (25% of the total cases) and the single most deciding and plausible factor too, followed by prior cardiac events 22% (out of 12, 5 had stroke, 3 had arrhythmias and 4 had failure); presence of cyanosis (11%), severe myocardial dysfunction with left ventricular ejection fraction < 40% (5%) and severe valvular outflow tract obstruction in the form of severe MS or AS (5%).

Stepping up of NYHA class from 1 / 2 to 3 / 4 was seen in 6 mothers and stepping down of NYHA class from 3 / 4 to 1 / 2 in 28 mothers . NYHA was static in 21 mothers. Out of 6 cases babies born to mothers with cyanosis, 4 of them were preterm IUGR and 2 were term AGA. Out of 14 cases having NYHA 3/4, 12 had LBW including 6 preterm IUGR, 2 IUGR, 4 preterm.

Poor neonatal outcomes in terms of low birth weight, prematurity, IUGR, were seen in those born to mothers with cardiac risk factors ($p<0.05$) [Table/Fig-5]. Maternal outcome was also poor. Out of 11 babies with ≥ 4 outcomes, 8 babies were born to mothers with risk factors and 3 babies were born to mothers without risk factors.

About 23 babies had good outcomes. Of these only 3 of those mothers had cardiac risk factors and the rest had no risk factors at all.

96% mothers were on one or more medications for cardiac disease during pregnancy and for nearly all of them medicines were started before delivery. 30 women were on frusemide alone or in combination with other drugs. 14 were on digoxin, 14 were on beta blockers, 13 were on anticoagulation. 6 mothers were on angiotensin converting enzyme inhibitors, 4 on calcium channel blockers. All these medications were taken either singly or in combination. Out of these, statistically significant adverse neonatal outcome in terms of LBW, IUGR, prematurity was found in those taking beta blockers.

MATERNAL OUTCOMES

15 women (28%) developed cardiac complications in pregnancy. 6 developed severe pulmonary arterial hypertension (11% of total 55 mothers) followed by 4 with thrombotic events (7%); 2 with severe left ventricular obstruction (4%); 2 with atrial fibrillation (4%) and 1 with congestive cardiac failure (2%). 2 mothers expired in the immediate postpartum period (4%). All belonged to NYHA 4.

5 (9%) cases were detected with heart disease newly during present pregnancy with the remaining women on regular follow ups with obstetrician and cardiologist. Out of these, 3 had cardiac risk factors with 1 maternal death whose baby also died. There were no significant differences in the neonatal outcomes in those mothers who were newly diagnosed and those whose disease was diagnosed early.

DISCUSSION

In our study of 55 pregnancies, 56% had RHD and 44% had CHD. This relatively higher incidence of CHD as compared to other studies is seen mainly because of the study being conducted in a tertiary cardiac care centre catering to all types of cardiac diseases. Few other studies had reported incidences of RHD ranging from 35% [4] to 88% [11] - 90% [9] and CHD ranging from 12% [8] - 64% [4]. Mitral valve regurgitation was the most common valvular lesion noted among our patients (94% of RHD) whereas ASD was the most common acyanotic CHD (25%) and Ebstein's anomaly was the most common cyanotic CHD encountered (13%). Other studies had reported that MS was the predominant valvular lesion [11].

NEONATAL OUTCOME

Out of 55 newborns, 32 (58%) neonates had complications. Neonatal outcome was adverse in majority of the babies (58%) and of this, 47% were born to mothers with cardiac risk factors. It was not as worse as was once thought due to the advances in medical field. Likewise other studies have reported the incidence of 39% [8].

Of the 25 babies born with LBW in our study, 14 (56%) were born to mothers with cardiac risk factors. This LBW may probably be attributed to maternal cardiac status and the effect of cardiac risk factors as discussed

subsequently. Male babies fared only slightly better than female babies as depicted by the observation of adverse outcomes in 47% male babies as compared to 53% female babies.

Prior studies had reported the incidence of preterm deliveries of 8% [12], 12% [11], 20-25% [5,8,13]. Our observations reiterated this observation again emphasizing the contribution of maternal risk factors on the outcome. This prematurity was probably due to spontaneous onset of labour.

There were 33% of babies with SGA of which 61% were born to mothers with cardiac risk factors. Other studies have reported the incidences of SGA at around 8% [5] - 21% [13]. 11% of babies had poor APGAR scores requiring active resuscitation all in the form of bag and mask ventilation. Other authors have reported incidences of 4% [8] to 9% [13].

14% of babies had congenital anomalies in our study in contrast to 2% incidence of congenital anomalies reported in another study [8]. 21% of babies with CHD were born to maternal CHD. None of the mother -baby diagnoses was found completely concordant. This is in concordance with the hereditary transmission of CHD of probable single gene origin. In other studies, incidence of CHD with maternal CHD ranged from 10-14% [12,14]. This slightly higher percentage was probably because of the smaller study population. This association of maternal and fetal CHD can be attributed to single gene autosomal dominant inheritance or multifactorial inheritance. There is no association quoted between maternal RHD and fetal CHD in literature. The fetal CHDs in cases with maternal RHD might be due to multifactorial inheritance.

Karyotyping was done on all babies born to mothers with bad obstetric history and those with suspected chromosomal syndromes. One baby born to mother with bad obstetric history and Eisenmenger's disease had ambiguous genitalia. Mother was not on any teratogenic drugs. Investigations revealed normal enzyme levels required in the synthesis of sex hormones and karyotyping showed normal 46XY. Another baby born to mother with truncus repair who had congenital cataract and hypocalcemia due to hypoparathyroidism was diagnosed to have chromosome 22q.11 micro deletion (Di - George syndrome). Chromosome 22q11.23 micro deletion is one of the common microdeletion syndromes inherited as an autosomal dominant disorder with variable clinical expression. Reported incidence of 22q11.23 micro deletion is 1 in 4000 to 1 in 6000 live births. Most of the cases are sporadic. Familial inheritance is seen in 5-10% of all cases. There were many other outcomes like feed intolerance, metabolic disturbances, sepsis etc. but none was substantial in terms of influence on neonatal outcome.

There were 4% neonatal deaths in this study which is comparable to 2% [13] and 5% [4] reported in literature. Only one was born to mother with cardiac risk factor. Both died due to sepsis and low birth weight consistent with other studies [4,11,13].

Comparison of neonatal outcome with maternal parameters.

Prior studies have focused on the risk stratification of women with cardiac disease so that they receive appropriate care and counselling [11,15]. These risk factors are prior events like arrhythmias, stroke, failure; presence of cyanosis, severe valvular outflow obstruction, NYHA 3 or 4 and severe myocardial dysfunction in the form of less than 40% ejection fraction.

Hemodynamic compromise secondary to valvular stenosis and the resulting decrease in uterine blood flow are probable explanations for the high incidence of impaired intrauterine fetal growth seen in this study of patients with valvular heart disease [6]. Maternal arrhythmias have been shown to cause fetal distress [6,7] and may be an additional mechanism leading to compromised uterine blood flow and fetal outcome. Maternal oxygen saturation is inversely proportional to neonatal birth weight; hence cyanosis causes increased incidence of IUGR, LBW, prematurity. The neonatal outcome was significantly adverse in terms of LBW, Prematurity, IUGR in those born to mothers with cardiac risk factors [6]. Prior studies have reported even worse perinatal outcomes in those babies born to mothers with cardiac and obstetric risk factors [4] but due to our study population being small, significant derivations could not be made.

33% mothers had ≥1 risk factor of which NYHA 3/4 was the most common which is comparable with other studies [11]. 47% babies were born to mothers with ≥1 cardiac risk factors. Out of 18 babies born to mothers with risk factors, only 17% had no adverse outcome reflecting the contribution of risk factors to neonatal outcome. 23 babies had good outcome (42%) of which only 3 were born to mothers with cardiac risk factors, again attributing this outcome to lack of cardiac risk factors in their mothers.

In our study, there was no difference in the neonatal outcome among newborns born to mothers with RHD and CHD groups as also between mothers with cyanotic and acyanotic heart disease groups. The reason for this could probably be attributed to the study population being low. On the contrary, earlier studies have shown that outcome in acyanotic heart disease was better than in cyanotic heart diseases [16].

51% mothers had undergone cardiac surgery, all within 5 years of present delivery. The neonatal outcome was no different in those born to mothers operated and those not operated. This could partly be because of their post operative cardiac status being compromised as a result of their original high risk cardiac condition and partly because of drugs like beta blockers. Out of these, 24% mothers had prosthetic valve insertions and were on anticoagulation but there was no statistically significant difference in the neonatal outcome between those with and without anticoagulation. There was no evidence of any congenital malformations or bleed.

96% mothers were on drugs for their cardiac disease. The neonatal outcome in the form of LBW, SGA and prematurity was significant in the group taking beta blockers. Other drugs did not cause any significant adverse outcome. Cardioactive drugs including diuretics, digitalis and beta blockers have been associated with impairment of uterine blood and in turn LBW, SGA and prematurity [6].

Out of the 5 newborns born to mothers who were newly detected to have cardiac disease, 3 were preterm and one of the 2 neonatal deaths was also seen in this group. However there was no significant difference in the neonatal outcomes in those mothers who were diagnosed earlier and those who were newly diagnosed in our study.

MATERNAL OUTCOME

2 mothers expired in the immediate postpartum period (4%). Others have reported 2% [4,13] to 3% [11]. Overall the outcome was good. The causes of death were due to congestive cardiac failure in most of the studies [4,11,13] but in our study it was due to Eisenmenger's disease with right heart failure with cardiogenic shock in one and due to post coarctoplasty with congestive failure in one mother. All of them belonged to NYHA 4 with cardiac risk factors, similar to other studies [4,5,11,13] .

Genetic testing becomes very essential to identify the associations between maternal heart disease and neonatal congenital anomalies / CHDs. Hence this knowledge of inheritance with accurate risks identified in mother to fetus transmission / risk of recurrence helps in future antepartum counseling and preventing the morbidity /mortality arising out of the birth of anomalous babies.

LIMITATIONS OF THE STUDY

This research was descriptive in nature with no intervention. Moreover the study population was small but still data was complete with good follow up with ready availability of obstetrician, cardiologist and neonatologist under a single roof.

CONCLUSION

Our study reiterated the significant association between cardiac risk factors in the mother and adverse neonatal outcome as was done earlier. Significant association was found between adverse neonatal events and cardiac risk factors in pregnant women. Stepping down of NYHA class from 3 / 4 to 1 / 2 is very much necessary to improve the outcome. Fetal echo followed by neonatal echo becomes essential in case of mothers with CHD as there are high chances of fetal transmission of CHD. The cause for 21% babies with CHD being born to mothers with CHD could be single gene defects, chromosomal defects or environmental causes.

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