

FREQUENCY OF FETOMATERNAL COMPLICATIONS IN PREGNANT FEMALES HAVING VALVULAR HEART DISEASE – A FOUR YEARS EXPERIENCE

Summera Aslam^a, Faizan Kashif^b, Kashif Zaheer^c, Aleena Kashif^a, Sibghat Ullah^d, Tayyiba Wasim^d

^aSir Ganga Ram Hospital Lahore. ^bGovernment Nawaz Sharif Hospital Yakki Gate Lahore. ^cKhawaja Safdar Medical College Sialkot. ^dSIMS/Services Hospital Lahore

Date of Submission : 12-06-2020; Date of Acceptance: 20-06-2020; Date of Publication: 15-02-2021

ABSTRACT:

BACKGROUND:

Several hemodynamic changes occur during pregnancy which can adversely affect the outcome, especially in presence of pre existing cardiac lesion. Valvular cardiac lesions are the commonest type of acquired cardiac lesions, most common cause being rheumatic heart disease especially in developing countries. Maternal morbidity and mortality remains a significant problem in untreated valvular lesions.

AIMS & OBJECTIVE:

To assess the frequency of fetomaternal complications in pregnant females with valvular heart disease.

MATERIAL & METHODS:

It was a 4 years cross sectional study from January 2014 to December 2017 conducted at Gynae Unit 3 SIMS/Services Hospital Lahore. All the pregnant patients with valvular heart disease were included in this study. All the data was collected from registers and patient files and entered in a detailed performa.

RESULTS:

During the period 14,473 deliveries were conducted. Out of these, 217(1.5%) patients had cardiac problem, with 147(68%) patients having valvular heart disease. Mean age of the patients was 27.67 ± 7.835 years. Regarding fetal outcome IUGR was noted in 40 (27.21%) patients, there were 35(23.8%) preterm births, 26 (17.7%) miscarriages, 6(4.1%) still births, 3(2%) neonatal deaths and no complications were noted in 36 (24.5%) patients. There was only 1 (0.68%) anomalous baby. Regarding maternal outcome, no complications were noted in 79 (53.74%) patients, 51 (34.69%) patients suffered from pulmonary edema, 9 (6.12%) patients had atrial fibrillation, and stroke was noted in 2 (1.36%) patients while 2 (1.36%) patients suffered from hypertension. There were only 4(2.72%) maternal deaths.

CONCLUSION:

The fetomaternal outcome is better in those patients where some form of treatment is provided for valvular cardiac lesion. Accurate diagnosis, tailored therapy and an understanding of the physiology and pathophysiology of pregnancy are necessary components of management. Multi disciplinary approach i.e. collaboration of a team of trained obstetricians, cardiologists, anesthetists and pediatricians may result in successful fetomaternal outcome in majority of cases.

KEY WORDS:

Valvular heart disease, Fetomaternal outcome, Pregnancy.

Correspondence : Sumera Aslam, Sir Ganga Ram Hospital, Lahore. Email: sumeraaslam68@yahoo.com

Author's Contribution: SA:Conducted the study and wrote the article. FK: Helped in review the article. KZ: Re-arranged data and corrected article. AK: Tables and figures. SU and TW made corrections and did the proof reading.

INTRODUCTION:

Pregnancy is associated with several hemodynamic changes which can adversely affect the outcome especially in presence of pre existing cardiac disease. Various hemodynamic changes in pregnancy include salt and water retention, decrease in systemic vascular resistance and hence decrease in blood pressure¹. Cardiac disease is one of the most important medical complications of pregnancy and also an indirect obstetric cause of maternal morbidity and mortality. It is estimated that about 2-4% of pregnancies are complicated by some sort of cardiac disease². Rheumatic heart disease (RHD) is still a major cause of cardiac disease in most of the developing countries³. In many cases the heart disease is diagnosed only at the time of pregnancy, which is the first encounter of a pregnant female with a healthcare provider. The maternal mortality rate in a pregnant female with cardiac disease can be as high as 7% and morbidity rate higher than 30% during pregnancy⁴. Valvular cardiac lesions are the commonest type of acquired lesions and most common cause being rheumatic heart disease especially in developing countries⁵. Rheumatic heart disease occurs due to single or repeated attacks of rheumatic fever leading to valvular deformity including deformity of valve cusps, shortening and fusion of chordae tendinae and fusion of commissures^{6, 7}. This leads to stenosis or regurgitation and the two often coexist. Mitral stenosis is the most common valvular lesion^{6, 8}. It is observed that pregnancy and its outcome is safer in patients who have undergone surgical correction of valvular lesion prior to pregnancy^{9, 10}. Maternal morbidity and mortality remains a significant problem in untreated valvular lesion or in those patients who are diagnosed with the lesion for the first time during pregnancy^{11, 12}. Keeping in view these facts, the present study was conducted to see the frequency of fetomaternal complications in pregnant patients with valvular heart disease and to evaluate the effect of treatment of valvular lesion on fetomaternal outcome.

MATERIAL AND METHODS:

It was a 4 years cross sectional study from January 2014 to December 2017 conducted at gynae unit 3 SIMS Lahore. All pregnant patients with known valvular cardiac disease, newly diagnosed, or acquired cardiac lesion were included in the study. Detailed history and clinical examination was undertaken in all the patients. All the booked patients with valvular cardiac lesions were managed

in collaboration with Punjab institute of cardiology (PIC) where patients were examined by Cardiologists and diagnosis was confirmed by history, clinical examination, ECG and Echocardiography. All patients were managed conservatively till term. In cases of symptoms of infection or de compensation like exertional dyspnoea, edema or palpitation, immediate admission was advised. In cases of maternal cardiac de compensation or fetal distress or those who could not tolerate stress of labour C-section was performed.

All pregnant patients with valvular heart disease were included in the study. Cardiac patients with gynecological disorders, obstetrical patients who presented with symptoms which mimic cardiac disease such as severe anemia or other medical disorders, pregnant cardiac patients other than valvular heart disease were excluded.

A performa was designed which included demographic data like age, parity, occupation ,address, phone no if available, educational status of patients, known cardiac patients or newly diagnosed, type of cardiac lesion, its timing of diagnosis and whether medical or surgical or both treatment taken and echocardiographic findings, number of antenatal visits in our hospital, obstetric history, family history especially of cardiac disease, maternal complications both cardiac and obstetrical during ante partum, intra partum or postpartum period or fetal complication like prematurity, intrauterine growth restriction perinatal mortality, details of mode of delivery, maternal and fetal outcome ,neonatal follow up for one week and maternal mortality.

Instrumental delivery was under taken if maternal effort was poor in second stage of labour. Fluid overload was avoided during labour and so was ergometrine in third stage. Prophylactic antibiotic was given to selected patients such as previous metallic valvular heart replacement or preterm labour with premature rupture of membranes (PROM). Patients undergoing spontaneous vaginal delivery were given narcotic analgesia. Low molecular weight heparin was given to patients with prosthetic valve replacement and switch over to oral anti coagulants was made after 72 hours. Digoxin, diuretics and anti-hypertensives were given as indicated in collaboration with cardiologist. Patients were kept in obstetrical ICU for 24 hours after delivery and discharged after three days for further follow up at Punjab Institute of Cardiology, Lahore. Data was analyzed using SPSS version 17. Comparisons of different groups were cross

Table 1: Patient Characteristics	
Total no. of deliveries	14473
Cardiac Patients	217(1.5%)
Non-Cardiac Patients	14256(98.5%)
Cardiac Patients	217
Valvular Heart Disease	147(68%)
Non-Valvular Heart Disease	70(32%)
Age(Years)	
<20	2(1.4%)
20-25	48(32.7%)
26-30	70(47.6%)
31-35	21(14.3%)
36-40	6(4.1%)
Gravida	
Primi Gravida	39(26.5%)
Gravida2-Gravida4	76(51.7%)
Gravida 5 onwards	32(21.8%)
Duration of Pregnancy	
More than 37 weeks	81(55.1%)
Less than 37 weeks	43(29.3%)
Less than 28 weeks	23(15.6%)
Valvular Heart Disease	
Mitral Valve only	92(62.6%)
Multiple Valves	49(33.3%)
Aortic Valve Only	4(2.7%)
Tricuspid Valve Only	1(0.7%)
Pulmonary Valve Only	1(0.7%)
Degree of Valvular Lesion	
Mild Mitral Stenosis	24(16.33%)
Moderate Mitral Stenosis	34(23.13%)
Severe Mitral Stenosis	62(42.18%)
Mitral Regurgitation	17(11.56%)
Aortic Stenosis	2(1.36%)
Aortic Regurgitation	4(2.72%)
Pulmonary Stenosis	2(1.36%)
Mixed Valvular Regurgitation	2(1.36%)
Ejection Fraction	
>50%	119(81%)
<50%	28(19%)
Treatment of Valvular Heart Disease	
Medical Therapy	58(39.5%)
Valve Replacement	32(22%)
PTMC(Percutaneous Transvenous Mitral Commissurotomy)	31(21%)
No Treatment	26(17.7%)
Mode of Deliveries	
Vaginal Delivery	72(49%)
Operative Vaginal Delivery	7(4.8%)
C Section	41(27.8%)
MVA (Manual Vacuum Aspiration)	14(9.5%)
Expulsion	13(8.8%)
Indication of Cesarean Section	
Maternal	9(22%)
Obstetrical	32(78%)

tabulated and significance was checked using chi square test.

RESULTS:

During this study, a total of 14473 deliveries

were conducted. Among these, there were 14256 (98.5%) non-cardiac patients whereas 217(1.5%) patients had cardiac disease. Among 217 cardiac patients, 147 (68%) patients had valvular heart

Table 2: Fetal Complications According to Treatment of Valvular Lesion

	No Treatment	Medical Treatment	PTMC	Valve Replacement	Total Count % of Total
Still Births	4(2.7%)	0(0%)	2(1.4%)	0(0%)	6(4.1%)
Preterm	6(4.1%)	18(12.2%)	8(5.4%)	3(2%)	35(23.8%)
Neonatal Deaths	0(0%)	1(0.7%)	1(0.7%)	1(0.7%)	3(2%)
Miscarriages	4(2.7%)	10(6.8%)	0(0%)	12(8.2%)	26(17.7%)
IUGR	11(7.5%)	8(5.4%)	10(6.8%)	11(7.5%)	40(27.2%)
Anomalous Baby	0(0%)	0(0%)	0(0%)	1(0.7%)	1(0.7%)
No Complications	1(0.7%)	21(14.3%)	10(6.8%)	4(2.7%)	36(24.5%)
Total	26(17.7%)	58 (39.5%)	31(21.1%)	32(21.8%)	147(100%)

Table 3: Maternal Complications According to Treatment of Valvular lesion

	No Treatment	Medical Treatment	PTMC	Valve Replacement	Total Count % of total
Maternal Deaths	4(2.7%)	0(0%)	0(0%)	0(0%)	4(2.7%)
Pulmonary Edema	13(8.8%)	19(12.9%)	8(5.4%)	11(7.5%)	51(34.7%)
Atrial Fibrillation	0(0%)	4(2.7%)	2(1.4%)	3(2.0%)	9(6.1%)
Stroke	0(0%)	1(0.7%)	1(0.7%)	0(0%)	2(1.4%)
Hypertension	0(0%)	1(0.7%)	0(0%)	1(0.7%)	2(1.4%)
No Complications	9(6.1%)	33(22.4%)	20(13.6%)	17(11.6%)	79(53.7%)
Total	26(17.7%)	58(39.5%)	31(21.1%)	32(21.8%)	147(100%)

Table 4: Fetal Complications Medical vs. Surgical Treatment of Valvular Lesion

	Medical Treatment	Surgical Treatment (PTMC & Valve Replacement)	Total Count % of Total	Chi ²	P Value
Still Births	0(0%)	2(1.7%)	2(1.7%)	-	-
Preterm	18(14.9%)	11(9.1%)	29(24.0%)	-	-
Neonatal Deaths	1(0.8%)	2(1.7%)	3(2.5%)	-	-
Miscarriages	10(8.3%)	12(9.9%)	22(18.2%)	-	-
IUGR	8(6.6%)	21(17.4%)	29(24.0%)	-	-
Anomalous Baby	0(0%)	1(0.8%)	1(0.8%)	-	-
No Complications	21(17.4%)	14(11.6%)	35(28.9%)	-	-
Total	58(47.9%)	63(52.1%)	121(100%)	12.247	P>0.05

Table 5: Maternal Medical vs. Surgical Treatment of Valvular Lesion

	Medical Treatment	Surgical Treatment (PTMC & Valve Replacement)	Total Count % of Total	Chi ²	P Value
Pulmonary Edema	19(15.7%)	19(15.7%)	38(31.4%)	-	-
Atrial Fibrillation	4(3.3%)	5(4.1%)	9(7.4%)	-	-
Stroke	1(0.8%)	1(0.8%)	2(1.7%)	-	-
Hypertension	1(0.8%)	1(0.8%)	2(1.7%)	-	-
No Complications	33(27.3%)	37(30.6%)	70(57.9%)	-	-
Total	58(47.9%)	63(52.1%)	121(100%)	0.133	P>0.05

Table 6: Effect of Treatment of Valvular Lesion on Fetomaternal Outcome

	Treatment	No Treatment	Total	Chi ²	P Value
No Fetal Complications	35(23.8%)	1(0.7%)	36(24.5%)	-	-
Fetal Complications	86(58.5%)	25(17.0%)	111(75.5%)	-	-
Total	121(82.3%)	26(17.7%)	147(100.0%)	7.279	P<0.05
No Maternal Complications	70(47.6%)	9(6.1%)	79(53.7%)	-	-
Maternal Complications	51(34.7%)	17(11.6%)	68(46.3%)	-	-
Total	121(82.3%)	26(17.7%)	147(100.0%)	4.648	P<0.05

PTMC: Percutaneous Transvenous Mitral Commissurotomy

disease. The mean age of the patients was 27.67 ± 7.835 years and majority of the patients 70(47.6%) were between the age of 26-30 years. We analyzed the data of 147 patients who suffered from valvular heart disease. Other patient characteristics regarding gravida, duration of pregnancy, type and degree of valvular lesion, ejection fraction, treatment of valvular heart disease, mode of delivery and indication of cesarean section is displayed in (Table 1).

Regarding fetal outcome, IUGR was noted in 40 (27.21%) patients, there were 35(23.8%) preterm births, 26 (17.7%) miscarriages, 6(4.1%) still births, 3(2%) neonatal deaths and no complications were noted in 36 (24.5%) patients. There was only 1 (0.68%) anomalous baby (Table 2).

Regarding maternal outcome, no complications were noted in 79 (53.74%) patients, 51 (34.69%) patients suffered from pulmonary edema, 9 (6.12%) patients had atrial fibrillation, and stroke was noted in 2 (1.36%) patients while 2 (1.36%) patients suffered from hypertension. There were only 4(2.72%) maternal deaths (Table 2). Maternal complications, fetal complications and maternofetal outcome with regards to treatment is given in tables-3,4 and 5.

DISCUSSION:

This study was aimed at assessing the frequency and type of valvular lesions in pregnant cardiac patients and to assess the fetomaternal complications and fetomaternal outcome in treated and untreated valvular cardiac pregnant patients.

The frequency of cardiac disease with pregnancy in our study was 1.5%. This is comparable to various studies in the past. According to B M Weiss et al, a total of 0.2% to 4% of all pregnancies were complicated by cardiac disease¹³. According to another study, about 2 to 4% of pregnant females suffer from cardiac disease¹⁴. Salam S et al

reported a relatively high prevalence of cardiac disease (4.3%) in pregnant patients¹⁵.

In our study out of a total of 217 cardiac patients, 147(68%) patients suffered from valvular heart disease. Valvular heart disease accounts for about 30% of the cardiac disease during pregnancy in developed countries whereas in developing countries 90% of the pregnant cardiac patients have valvular heart disease^{16, 17}. In another study, Priya et al reported 39.7% incidence of rheumatic heart disease among pregnant cardiac patients¹⁸.

In our study, 92(62.64%) patients had mitral valve involvement which is the commonest valvular lesion. This correlates well with various studies in literature. Priya et al reported 57% of isolated mitral valve lesions in their study of pregnant cardiac patients in India¹⁸. Sheela et al have also reported similar observations regarding mitral valve involvement in maternal cardiac complications in women with cardiac disease¹⁹.

Regarding mode of delivery, 72 (49%) patients had vaginal deliveries whereas operative vaginal delivery was conducted in 7 (4.8%) patients. Sethuraman et al published a study of 129 pregnant patients with valvular heart disease and incidence of vaginal delivery was 58% and outlet forces were applied in 18.6% patients²⁰. In our study, 41 (27.8%) patients underwent C section which is relatively low as compared to various studies in the past. Behloul et al reported a study where the incidence of elective C section was 39.6% and urgent C section was done in 14.5% patients²¹. Priya et al published a study about maternal outcomes of rheumatic heart disease in pregnancy and reported that 30% of women underwent C-section for various indications¹⁸. Sethuraman et al reported a lower incidence of C section (24.1%) in their study of maternal and fetal outcomes in rheumatic heart

disease in pregnancy²⁰.

Regarding fetal outcome in our study, no complication was noted in 36(24.5%) births, IUGR was noted in 40(27.21%) patients and there were 35(23.8%) pre term babies. Still births were noted in 6(4.1%) cases. There were 26(17.7%) miscarriages, 3(2%) neonatal deaths and only 1(0.68%) baby was anomalous (Table 2). Behloul et al reported 8% still births in their study of pregnancy outcome in rheumatic mitral stenosis with and without surgical corrections and all still births were reported in uncorrected group²¹. The study published by Sethuraman et al in 2014 reported 4.8% pre term births in surgically corrected patients and 26.3% in uncorrected cases. Similarly, still births were noted in 0.8% cases in both corrected and uncorrected lesions. Perinatal death was 2.4% in operated cases as compared to 11.8% in non-operated cases²⁰.

Regarding maternal outcome in our study, no maternal complications were noted in 79(53.74%) patients. Pulmonary edema was noted in 51(34.69%) patients, atrial fibrillation was seen in 9(6.12%) patients, stroke was noted in 2(1.36%) patients, 2(1.36%) patients had hypertension and there were 4(2.72%) maternal deaths (Table 3). Sethuraman et al published a study about fetal and maternal outcome in rheumatic disease where 3.9% patients had PIH, arrhythmia was noted in 0.8% patients and there were 4(6.7%) maternal deaths²⁰. In our study the maternal death rate was 2.72% which is comparable to various studies in the past. Sawhney et al 2003 reported 2.05% maternal deaths²² whereas Silversides CK et al 2003 noted 5-7% of maternal deaths in their study²³.

In our study, medical treatment was imparted to 58(47.9%) patients, 32(22%) patients had valve replacement, 31(21%) patients had PTMC where as 26(17.7%) patients received no treatment (Table 1). This observation also correlates with the literature as most of the pregnant patients with cardiac disease are being treated medically^{20, 24}. In our study, we could not conclude about the most effective treatment of valvular heart disease in pregnancy. There is insufficient evidence to define the most effective treatment of valvular heart disease in pregnancy to improve fetomaternal outcome²⁵. Treatment choices need to be optimized for both mother and fetus. Surgical procedures like PTMC and valve replacement are suitable for the younger cardiac patients²⁶.

We also compared fetomaternal outcome in patients who got medical treatment vs. surgical

treatment (PTMC & Valve replacement) Table 4 & 5. Although fetal outcome was slightly better with fewer complications in those patients who were medically treated for their valvular lesion but the results were not statistically significant ($P>0.05$) Table 4. Regarding maternal outcome in our patients, it was almost similar in both medically and surgically treated valvular cardiac patients ($P>0.05$) Table 5. Dhivya Sethuraman et al (2014) reported that there was no significant association between the incidence of CCF in the surgically operated and not operated patients. However, incidence of preterm labour and preterm babies was more (26.3%) in non operated cases as compared to 4.8% in operated cases²⁰. In our study, the incidence of preterm babies was 14.9% in medically treated patients as compared to 9.1% in surgically treated patients. Bahloul M et al conducted a study about pregnancy outcome in rheumatic mitral stenosis and concluded that maternal complications including cardiac failure, pulmonary hypertension and arrhythmias were significantly more in uncorrected and untreated lesions similarly neonatal outcome was better in mitral stenosis corrected group regarding birth weight, still births and admission to paediatric care units.²¹

We also compared fetomaternal outcome in 121 (82.3%) patients who received some form of treatment (medical, PTMC or valve replacement) with those 26 (17.7%) who did not receive any treatment for their valvular lesion (Table 6). The fetal outcome was much better in those patients who received some form of treatment. Thirty five (23.8%) patients had no fetal complications in this group as compared to 1 (0.7%) patient with no fetal complications where no treatment was given ($P<0.05$).

Maternal outcome was also better in those 121 (82.3%) patients who got some sort of treatment for valvular lesion. (Table 6) In this group, 70(47.6%) patients had no maternal complications whereas 51(34.7%) patients had different forms of maternal complications. In comparison, 26 (17.7%) patients who had no treatment for their valvular lesion, only 9 (6.1%) patients had no maternal complications and 17 (11.6%) patients suffered from some sort of maternal complications ($P<0.05$). These observations clearly show that treatment of valvular cardiac lesion significantly improves the fetomaternal outcome in pregnant patients. This is consistent with various studies in the past.²⁶⁻³⁰

CONCLUSIONS:

Pregnancy with cardiac disease especially valvular

heart disease is still a major problem especially in developing countries. The incidence of disease, fetal and maternal complications and fetomaternal outcome is comparable to various studies in the past. The fetomaternal outcome is better in those patients where some form of treatment is provided

for valvular cardiac lesion. . Accurate diagnosis, tailored therapy and an understanding of the physiology and pathophysiology of pregnancy are necessary components of management. Multi disciplinary approach i.e. collaboration of a team of trained obstetricians, cardiologists, anesthetists and pediatricians may result in successful fetomaternal outcome in majority of cases.

References:

1. Chapman AB, Abraham WT, Zamudio S, Coffin C, Merouani A, Young D et al. Temporal relationships between hormonal and hemodynamic changes in early human pregnancy. *Kidney international*. 1998 Jan 1; 54(6):2056-63.
2. Arnoni RT, Arnoni AS, Bonini RC, de Almeida AF, Neto CA, Dinkhuysen JJ, et al. Risk factors associated with cardiac surgery during pregnancy. *The Annals of thoracic surgery*. 2003 Nov 1; 76(5):1605-8.
3. Hema Priya L, Bhandiwad A, Desai N, Kondareddy T. Maternal outcomes of rheumatic heart disease in pregnancy. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2017 March; 6(3):802-6.
4. Pushpalatha K. Cardiac diseases in pregnancy-A review. *JIMSA*. 2010 Oct; 23(4):269-74.
5. Salam S, Mushtaq S, Mohi-ud-Din K, Gul I, Ali A. Maternal and fetal outcome in pregnancy with heart disease in tertiary care hospital in India. *Int. J. Reprod. Contracept. Obstet. Gynecol*. 2017 Sep; 6(9):3947-51.
6. Bhatla N, Lal S, Behera G, Kriplani A, Mittal S, Agarwal N, Talwar KK. Cardiac disease in pregnancy. *International Journal of Gynecology & Obstetrics*. 2003 Aug; 82(2):153-9.
7. Charlotte L. Deans, Anselm Uebing, Philip B. Steer. Cardiac disease in Pregnancy. *Progress in Obstetrics and Gynaecology*, 17th edition 164-183.
8. Sawhney H, Aggarwal N, Suri V, Vasishta K, Sharma Y, Grover A. Maternal and perinatal outcome in rheumatic heart disease. *Int J Gynaecol Obstet*. 2003 Jan; 80(1):9-14.
9. Malhotra M, Sharma JB, Arora P, Batra S, Sharma S, Arora R. Mitral valve surgery and maternal and fetal outcome in valvular heart disease. *Int J Gynaecol Obstet*. 2003 May; 81(2):151-6.
10. Routray SN, Mishra TK, Swain S, Patnaik UK, Behera M. Balloon mitral valvuloplasty during pregnancy. *Int J Gynaecol Obstet*. 2004 Apr; 85(1): 18-23.
11. Desai DK, Adanlawo M, Naidoo DP, Moodley J, Kleinschmidt I. Mitral stenosis in pregnancy: a four-year experience at King Edward VIII Hospital, Durban, South Africa. *BJOG*. 2000 Aug; 107(8): 953-8.
12. Laura L. Klein, MD, Henry L. Galan, MD. Cardiac disease in pregnancy. *Obstet Gynecol Clinics of North America* 31(2004)429-459.
13. Weiss BM, von Segesser LK, Alon E, Seifert B, Turina MI. Outcome of cardiovascular surgery and pregnancy: a systematic review of the period 1984-1996. *American journal of obstetrics and gynecology*. 1998 Dec 1; 179(6):1643-53.
14. Arnoni RT, Arnoni AS, Bonini RC, de Almeida AF, Neto CA, Dinkhuysen JJ, et al. Risk factors associated with cardiac surgery during pregnancy. *The Annals of thoracic surgery*. 2003 Nov 1; 76(5):1605-8.
15. Salam S, Mushtaq S, Mohi-ud-Din K, Gul I, Ali A. Maternal and fetal outcome in pregnancy with heart disease in tertiary care hospital in India. *Int. J. Reprod. Contracept. Obstet. Gynecol*. 2017 Sep; 6:3947-51.
16. Siu SC, Sermer M, Colman JM, Alvarez AN, Mercier LA, Morton BC, Kells CM, et al. Prospective multicenter study of pregnancy outcomes in women with heart disease. *Circulation*. 2001 Jul 31; 104(5):515-21.
17. Carapetis JR, Steer AC, Mulholland EK, Weber M. The global burden of group a streptococcal diseases. *The Lancet infectious diseases*. 2005 Nov 1; 5(11):685-94.
18. Hema Priya L, Bhandiwad A, Desai N, Kondareddy T. Maternal outcomes of rheumatic heart disease in pregnancy. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2017 Mar; 6(3):802-6.
19. Sheela CN, Karanth S, Patil CB. Maternal cardiac complications in women with cardiac disease in pregnancy. *Int J Pharm Biomed Res*. 2011; 2(4):261-5.
20. Sethuraman D, Ramachandran N, Noorjahan S, Kanna V. Maternal and fetal outcomes in rheumatic heart disease in pregnancy. *International Journal of Research in Medical Sciences*. 2014 Nov; 2(4):1632-37.
21. Bahloul M, Michael A, Kandeel MY, Abbas AM. Pregnancy outcome in rheumatic mitral stenosis

- patients with and without surgical correction: a prospective cohort study. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2017 Jun; 6(6):2342-6.
22. Sawhney H, Aggarwal N, Suri V, Vasishta K, Sharma Y, Grover A. Maternal and perinatal outcome in rheumatic heart disease. *International Journal of Gynecology & Obstetrics*. 2003 Jan; 80(1):9-14.
 23. Silversides CK, Colman JM, Sermer M, Siu SC. Cardiac risk in pregnant women with rheumatic mitral stenosis. *American Journal of Cardiology*. 2003 Jun 1; 91(11):1382-5.
 24. Akhtar N, Sultana T, Sayeeda S, Parveen T, Begum F. A Study on Pattern of Heart Disease and Maternal and Fetal Outcome of Pregnancy in a Tertiary Level Hospital. *University Heart Journal*. 2015; 11(1):36-41.
 25. Henriquez DD, Roos-Hesselink JW, Schalij MJ, Klautz RJ, Helmerhorst FM, de Groot CJ. Treatment of valvular heart disease during pregnancy for improving maternal and neonatal outcome. *Cochrane Database of Systematic Reviews*. 2011(5).
 26. Sliwa K, Johnson MR, Zilla P, Roos-Hesselink JW. Management of valvular disease in pregnancy: a global perspective. *European heart journal*. 2015 May 7; 36(18):1078-89.
 27. Nanna M, Stergiopoulos K. Pregnancy complicated by valvular heart disease: an update. *Journal of the American Heart Association*. 2014 Jun 5; 3(3):e000712.
 28. Gelson E, Johnson M, Gatzoulis M, Abselm U. Cardiac disease in pregnancy. Part 2: acquired heart disease. *The Obstetrician & Gynaecologist*. 2007 Apr; 9(2):83-7.
 29. Anthony J, Osman A, Sani MU. Valvular heart disease in pregnancy. *Cardiovascular journal of Africa*. 2016 Mar; 27(2):111.
 30. Dennis A. Valvular heart disease in pregnancy. *International journal of obstetric anaesthesia*. 2016 Feb 1; 25:4-8.