

# Maternal Mortality Due to Cardiovascular Disease in the Netherlands: a 21 years' Experience

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## **Objective**

Cardiovascular disorders are the leading cause of indirect maternal mortality in Europe. The aim of this study is to present an extensive overview concerning the specific cardiovascular causes of maternal death and identify factors for possible improvement of care to decrease cardiovascular maternal mortality in the Netherlands.

## **Methods**

We evaluated all cases of cardiac maternal death collected by a systematic national confidential enquiry of maternal deaths published by the Dutch Maternal Mortality Committee (MMC) over a 21-year period in the Netherlands.

## **Results**

The 96 maternal deaths were largely caused by aortic dissection (n=20, 21%), ischemic heart disease (n=17, 18%), cardiomyopathies (including peripartum cardiomyopathy and myocarditis, n=20, 21%) and (unexplained) sudden death (n=27, 28%). Most deaths occurred postpartum (n=55, 55%). Factors for improvement of care were identified in 27 cases (28%). In 60% these factors were health care provider related, and mainly consisted of improvement of recognition of the diagnosis.

## **Conclusion**

The main causes of maternal mortality are in line with other European reports. Care providers should be educated about the incidence, presentation and diagnosis of cardiovascular disease during pregnancy.

# **Left Ventricular Diastolic Function in Pregnant Women Suffering From Dyspnea**

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## **Background**

Dyspnea is a common symptom in healthy pregnant women in the absence of any cardiac or respiratory pathology. Different theories were proposed to explain the mechanism of shortness of breath in pregnant women; however its precise mechanism remains unclear.

## **Aim**

The aim of our study: to conduct a comparative assessment of the left ventricular diastolic function in pregnant women with and without dyspnea.

Study design- prospective comparative trial. Participants – 154 healthy pregnant women.

## **Method**

The participants were asked to assess their breathlessness using the MRC breathlessness scale and then underwent transthoracic echocardiographic assessment including standard M mode measurements of left ventricle, left atrium, and aortic root in parasternal long axis view, mitral valve inflow assessment, pulmonary veins flow assessment and tissue Doppler imaging.

## **Results**

MRC scores distribution: Grade 1- 46 women, Grade 2 – 47 women, Grade 3 – 56 women, Grade 4-5 women. The comparison was made between asymptomatic women (MRC Grade 1) and with women with dyspnea (Grades 2,3,4). The data is summarized in the tables 1 and 2.

## **Conclusions**

Older women are more likely to suffer from dyspnea. 2. The appearance of dyspnea was correlated with lower e-septal and e-lateral amplitude measured by tissue Doppler. Therefore, dyspnea during pregnancy seems to be associated with reduced left ventricular compliance.

## Results

parameter	Mean in Grade 1±ST deviation	Mean in Grade 2,3,4±ST deviation	P-value
Age	28.478±4.75	30.898±4.89	<b>0.005</b>
PregN	1.761±0.9	2.213±1.59	0.027
Week	26.326±4.12	26.778±4.29	0.546
Height	163.696±5.8	162.806±6.73	0.436
Weight	71.152±10.7	72.699±11.52	0.438
BMI	26.592±4.11	27.439±4.06	0.24
HR	82.500±12.18	80.194±11.8	0.273

## Tissue Doppler

parameter	Mean in Grade 1±ST deviation	Mean in Grade 2,3,4±ST deviation	P-value
e septal	13.609±2.5	11.995±2.5	<b>0.00</b>
Eseptal	7.166±1.7	7.590±2.1	0.227
e lateral	18.304±3	16.256±3.1	<b>0.00</b>
Eelateral	5.344±1.4	5.585±1.6	0.364
Eemean	6.042±1.3	6.363±1.6	0.233
septal	9.870±2.2	9.741±2.2	0.738
lateral	8.717±1.8	9.519±2	0.023
Tei index a	415.761±26.5	417.352±33.1	0.774
Tei index b	286.652±25	283.583±25.8	0.496
Tei index	0.457±0.11	0.478±0.12	0.316

# Maternal Antenatal Beta-Blockade: An Independent Risk Factor for Fetal Growth Restriction

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## Objective

To investigate whether beta-blockade is an independent risk factor for fetal growth restriction in non-hypertensive women.

## Design

Retrospective cohort study.

## Population

100 Deliveries between 2002 and 2016 at St Michael's Hospital, Bristol, (43 pregnant women prescribed beta-blockers for non-hypertensive cardiac disease and 57 matched controls).

## Exclusion criteria

Smoking, left sided obstructive heart disease, impaired systemic ventricular function, fetal congenital abnormalities and pregnancy specific conditions affecting fetal growth.

## Methods

43 Women prescribed beta-blockers for non-hypertensive cardiac disease, were identified from specialist antenatal clinic records and 57 matched controls were selected from midwifery booked pregnancies. Data was collected from maternity and neonatal databases including maternal age, ethnicity, parity, body mass index, mode of delivery, birth weight, gestation at delivery, fetal gender, admission to neonatal unit and neonatal hypoglycemia. Gestation-specific birth weight centiles were calculated using the World Health Organisation (WHO) calculator. Analysis was undertaken in STATA software, using linear regression modelling considering appropriate confounders. Chi-squared test determined the likelihood of a small for gestational age (SGA) infant for cases and controls. SGA was defined as delivery of an infant with birth weight below the 10<sup>th</sup> gestation specific centile.

## Results

Compared to controls, maternal beta-blockade was associated with a 211g decrease in birth weight (95% CI: 41-381g; p= 0.016), correcting for fetal gender and gestation.

Women taking beta-blockers were 9.3% (95% CI: 0.6-18.0%; p = 0.019) more likely to deliver a SGA infant with birthweight 3rd centile and 12.8% (95% CI: 0.7-24.8%; p= 0.027) with birthweight 10th centile.

## Conclusion

Maternal beta blockade resulted in more women delivering a SGA infant, with an overall significant reduction in birthweight compared to controls. All pregnant women prescribed beta-blockers should be made aware of this association and where possible alternative medications should be prescribed.

## **Peripartum Cardiomyopathy (PPCM) or Non-compaction of the Left Ventricular Myocardium (NVM)?**

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### **Background**

PPCM is an idiopathic cardiomyopathy, presenting with LV systolic dysfunction (LVEF 45%) towards the end of pregnancy or in the months following delivery, where no other cause of heart failure is identified.

NVM is a congenital disease characterised by trabeculations and deep intertrabecular recesses in the endocardial wall that could cause heart failure, ventricular arrhythmia and systemic embolism.

### **Objective**

To evaluate the clinical outcome of a pregnant woman with systolic dysfunction.

### **Methods**

We collected cardiologic and obstetrics data about woman, who got pregnant despite non-completely recovered of her EF after previous delivery.

### **Results**

A 36 years woman became pregnant on September of 2016. On 2012, two days after a caesarean section (CS), she developed an acute pulmonary Oedema with heart failure (EF 25%). 6 months later, the EF was 40% and there were some trabeculations in the endocardial wall.

During the pregnancy, the cardiological parameters have been steady (EF 40%, normal value of NT-proBNP, NYHA I) with the therapy based on carvedilol, cardioaspirin (enoxaparin sodium from 17week) and nitroglycerin patch. From 33weeks the patient developed dyspnea (NYHA II-III), bibasilar crackles, low EF (35%) and worsening of mitral regurgitation from mild to severe: the furosemide was added. A CS was performed at 34weeks. A male baby of 2400 gr (64°centile) was born. The patient was admitted in the intensive care unit to have hemodynamic stabilization with amines. Two days after surgery she moved to the cardiology department. The echocardiography shows an EF 20%, ventricular trabeculations and severe mitral regurgitation. Progressively with appropriate pharmacological therapy the patient recovered her heart function up to EF 35%.

### **Conclusion**

Two different conditions are overlapped: PPCM and NVM. Is this a congenital silent cardiopathy that has been evocated by the hormonal and hemodynamic stress of pregnancy or a peripartum cardiomyopathy? The question is still opened.

## Is It Safe to Consider A Vaginal Birth for Women with Marfan Syndrome?

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### Background

The 2010 American guidelines recommend Caesarean section for delivery in women with Marfan syndrome and an aortic root diameter  $\geq 40$ mm, while the 2011 European guidelines recommend it if the aortic root  $\geq 45$ mm. Very few studies have reported pregnancy outcome according to pre-pregnancy diameter of the aorta. There is no evidence that caesarean delivery protects against aortic dissection.

### Objective

To assess obstetrical outcomes according to pre-pregnancy aortic root diameter.

### Methods

This is a retrospective cohort study including all pregnant women with Marfan Syndrome according to the 1994 or 2010 Ghent criteria and/or a FBN1 mutation who were followed prospectively in our center between 1994 and 2017. Women with prior aortic surgery were excluded. All women were taking  $\beta$ -blockers during pregnancy and were allowed to undergo a vaginal delivery with early epidural, delayed pushing and delivery with outlet forceps. Serial echocardiograms were performed early in the 2<sup>nd</sup> trimester and monthly in the 3<sup>rd</sup> trimester. Obstetrical outcomes were analysed in 2 groups according to prior aortic root diameter: group 1 (40mm) and group 2 (40-45mm).

### Results

Twenty-six pregnancies in 19 women were recorded. Results are reported in Table 1. Among primipara (N=19), vaginal delivery rate was 73.3% (11/15) for women in group 1 and 100% (4/4) in group 2. Overall, 80.8% (21/26) had a vaginal delivery. Preterm birth occurred in 23.1% with a mean gestational age of  $34.8 \pm 2.3$  weeks (range: 31.1-36.7). Indications for elective caesarean delivery were breech presentation in group 1 and breech presentation (2 patients), acute type B aortic dissection at 31 weeks (1 patient) and Harrington rods precluding loco-regional anesthesia (1 patient) in group 2.

### Conclusion

Vaginal delivery with rigorous pain control and avoidance of Valsalva maneuver may be safely considered in women with Marfan Syndrome and an aortic root diameter  $\leq 45$ mm.

# Worse Outcomes in Younger Women with Peripartum Cardiomyopathy

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## Background

Advanced maternal age is a known risk factor for peripartum cardiomyopathy (PPCM), but whether age influences prognosis and outcomes is unknown.

## Methods

Patients with PPCM at a tertiary care center were retrospectively identified by key word search of the electronic medical records. Each record was manually reviewed. Clinical, demographic, echocardiographic, and short- and long-term outcomes were reviewed. Patients were divided into younger (age = 25 years) versus older (age: 25 years) cohorts based on age at time of diagnosis.

## Results

Of 1058 charts identified and reviewed, 149 patients met diagnostic criteria for PPCM. The median age of diagnosis was 29 (range 17-46). The younger cohort (women = 25 years) consisted of 50 women with median duration of follow up of 10.6 years, compared to 99 women in the older cohort (age: 25 years) with median duration of follow up of 7.9 years. Among the younger cohort, mean left ventricular ejection fraction (EF) at diagnosis was 25%, and 36% at the end of follow up. Among the older cohort, mean EF at diagnosis was 25%, and 45% at the end of follow up. Mortality was 32% among the younger cohort compared to 6% among the older cohort ( $p$  0.0001). In the younger cohort, 17 out of 50 women (34%) suffered 23 adverse events (1 intra-aortic balloon pump, 4 ventricular assist devices, 2 transplants, and 16 deaths). In the older cohort, 17 out of 99 women (17%) suffered 23 adverse events (4 intra-aortic balloon pumps, 8 ventricular assist devices, 5 transplants, and 6 deaths).

## Conclusions

Despite similar initial EF, younger women with PPCM have less improvement in EF and higher rates of adverse events including death.

# Use of Beta Blocker and the Risk of Small-for-Gestational-Age Infant among Pregnant Women with Heart Disease

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## Background

Beta blockers are commonly prescribed to pregnant women with heart disease. An increased risk of intrauterine growth restriction and small-for-gestational-age (SGA) infants has been demonstrated in pregnancies in women with beta blocker treated chronic hypertension. Few studies have examined the same relation in women treated with beta blocker due to preexisting heart disease. The aim of this study was to examine exposure to beta blocker and the risk of delivering an SGA infant in a cohort of women with heart disease.

## Methods

We performed a retrospective cohort study, including women with registered preexisting heart disease giving birth at a tertiary birth center in Oslo, Norway, between 2006 and 2015. We compared mean birthweight, z-score, and proportions of SGA infants (z-score 10th percentile) in non-exposed women and women exposed to two different dose levels of beta blockers ( $\geq 75$  mg metoprolol). Associations were determined through multivariable linear and logistic regression analyses.

## Results

Of 540 pregnancies identified, 30% were treated with beta blocker, among whom 87% with metoprolol. Average birthweight of newborns to women exposed to beta blocker was 334 grams less than in non-exposed women (B=-334, 95% CI -451, -225). After adjustments for severity of heart disease and gestational age, a significant difference of 88 grams per dose level remained. The risk of SGA in babies to women treated with the highest dose level was increased four times compared to non-exposed women (OR 4.4, 95% CI 2.1-9.4). Newborns of both exposed and non-exposed women had lower z-scores than the national reference.

## Conclusion

Exposure to beta blockers is associated with an up to four-fold increased risk of SGA in offspring to women with heart disease and a moderate decrease in mean birthweight. Pregnant women with heart disease should be informed that medication with beta blocker is safe; however, surveillance of fetal growth is important to identify SGA fetuses.



## Management of pregnancy, Labour and delivery in a Pregnant Woman after Mustard Repair of the Great Arteries Transposition (TGA)

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### Background

Good maternal and fetal outcomes in a pregnant woman after Mustard repair of TGA are a challenge. The hemodynamic changes that occur during the pregnancy could increase the risk of developing both cardiological events (arrhythmias, and worsening of the right ventricular function) and obstetrics ones (late onset growth restriction and preeclampsia)

### Case

A 41 years old woman with a Mustard repaired TGA, a previous atrial flutter cardioverted, a mild tricuspid valve failure and a defect of the interventricular septum, underwent oviduction in October 2016 for primitive sterility. Before the pregnancy her right ventricle function was good under enalapril 5mg/die. At sixteenth week she developed signs of overload of the systemic right ventricle and her blood pressure increased so we introduced furosemide 12.5mg/die. In the following weeks her cardiac function and NT pro BNP values were good; at thirtieth week her ECG Holter showed twelve episodes of TVNS and one episode of atrial tachycardia, she developed lower edema so we introduced bisoprolol 1.25mg/die and increased furosemide up to 25mg/die. At thirty-fifth week because of the high blood pressure and a of mild intrauterine growth restriction we increased the dosage of furosemide up to 37.5 mg/die and of bisoprolol up to 2.5mg/die and hospitalized her. The labour was induced at thirty-seventh week by endocervical balloon then endovaginal prostaglandins, artificial amniorexis and oxytocin infusion, supported by epidural analgesia. A baby girl of 2580g (AGA, twenty-ninth centile) was born by a vaginal delivery; the patient's cardiac function and blood pressure were fine in the following days and she was dismissed with just enalapril 5mg/die; her clinical conditions one month later were comparable to the ones before the pregnancy

### Conclusions

The pregnant patients with systemic right ventricle are more likely to develop heart failure and need a close multidisciplinary follow up.

## **Outcomes in Women with Mechanical Heart Valves – Issues Surrounding Anticoagulation**

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### **Background**

In 2017, the United Kingdom Obstetric Surveillance System report on pregnant women with mechanical heart valves (MHV) documented 9% maternal mortality, 41% maternal morbidity and 47% adverse fetal outcomes. Low molecular weight heparin (LMWH) was used in 71% but monitoring was inconsistent.

### **Methods**

Retrospective case-note review of women with MHV delivering  $\geq 24$  weeks of gestation at Chelsea and Westminster and Royal Brompton Hospitals, with a focus on the anticoagulation regimens at 10 and 20 weeks of gestation, monitoring and management of anticoagulation in the peri-delivery period.

### **Results**

Fourteen women with 18 pregnancies were included. Median age was 32 years, most were white British and nulliparous. Six had MHV in the aortic position, five in the mitral position and three in both positions. All were on LMWH at 10 weeks and all but one at 20 weeks of gestation. Most had peak anti-factor Xa assays performed only at monthly intervals. Levels ranged from 0.39 to 1.51IU/mL, mean 0.82IU/mL; most achieved therapeutic levels in the second trimester. The management of anticoagulation around the delivery was inconsistent. Delivery was by emergency Caesarean section (n=7, 6 fetal indications, 1 failure to progress), elective Caesarean section (n=6, 4 obstetric, 2 cardiac indications) and instrumental vaginal delivery (n=3, for poor progress). There were no maternal deaths or thrombotic complications; four had subcutaneous haematomas and one, a pelvic haematoma. There were two neonatal deaths, one intra-uterine death at 30 weeks (hydrocephalus) and one baby was severely growth restricted.

### **Conclusion**

There were few maternal and fetal complications in our review but considerable variation in anticoagulation around delivery and in the postnatal period. Ensuring adequate anticoagulation is difficult with the use of LMWH and could explain UKOSS outcomes. The development of an optimum strategy for anticoagulation for these women can probably only be developed by collaborative multicenter studies.

## **A Case Life-Threatening SVT in Pregnancy**

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### **Objective**

To report a refractory case of SVT resulting in maternal cardiomyopathy and fetal loss.

### **Methods & results**

A primigravida was referred at 16 weeks of gestation for maternal tachycardia (180-200 bpm). ECG confirmed a case of SVT but it was refractory and persisted despite repeated dose of ATP and isoptin, betaloc and flecainide. Her systolic BP was about 90 mmHg with HR 180-210 bpm. She finally agreed for catheter ablation with limited fluoroscopy. However, she requested home leave and did not return for the procedure and refused all medical treatment. She was readmitted at 18 weeks presenting with hypotension with unrecordable BP. Echocardiogram showed global hypokinesia with LVEF of 15%. All cardiologists in the public sector who can perform ablation were out-of-town at that time so no immediate RFA could be available. In view of the critical condition, she was given amiodarone even a potential risk of hypo/hyperthyroidism, congenital goitre, neonatal bradycardia, potential benefit of drug outweighs the potential harm. She suffered from hypotension down to 70/40 after the loading dose of amiodarone. Heparin was given for thromboprophylaxis, gave the risk of intramural thrombus with tachycardia, cardiomyopathy, immobilization and prothrombotic state in pregnancy. She presented with rupture of membranes followed by spontaneous abortion of the fetus within 1 hour. Blood loss was only 150 ml. She finally had a successful EPS and RFA under local anaesthesia (135 min procedural time) and recovered from the cardiomyopathy.

### **Conclusion**

RFA is rarely required in SVT in pregnancy except for cases who are refractory of standard medical treatment. The radiation dose can be minimized with limited or zero fluoroscopy.

# Adverse Pregnancy Outcomes in Women Diagnosed with Coronary Microvascular Dysfunction: A Case Series

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## Introduction

Coronary microvascular dysfunction (CMD) is associated with recurrent chest pain (CP), rehospitalization and adverse cardiovascular outcomes. A proportion of women with CMD are of childbearing age, however, the frequency of adverse pregnancy outcomes in this population is unknown.

## Objectives

To characterize frequency of symptoms, need for medical attention and adverse pregnancy outcomes in women with CMD.

## Methods

Women previously enrolled in a prospective CMD cohort were screened for pregnancy following enrollment. CMD was diagnosed by invasive coronary reactivity testing (CRT), demonstrating coronary microvascular dysfunction (coronary flow reserve (CFR) th percentile for gestational age).

## Results

Five of 21 (23.8%) patients of childbearing age (age range 18-44) became pregnant following CMD diagnosis. Patient 1, 4 and 5 received aspirin and only Patient 5 required anti-anginal therapy (labetalol) during pregnancy. CRT and pregnancy data are presented in Table 1. Most patients reported stable CP, while patient 5 reported an increase in frequency of CP, requiring an ER visit. None were hospitalized for CP or experienced, GHTN, GDM, preeclampsia/eclampsia, MI or death. Patient 2 experienced preterm delivery due to non-reassuring fetal biophysical profile. The neonate of Patient 1 was small for gestational age.

## Conclusion

In this case-series of five women with CMD who became pregnant, increasing CP and ER visits for CP during pregnancy were not commonly observed. Two patients experienced adverse pregnancy outcomes and no adverse cardiovascular events occurred. Further studies are warranted to explore adverse pregnancy outcomes in this population.

**Table 1: Clinical data, coronary reactivity testing results and pregnancy details**

Patient	Age at pregnancy	Obstetrical history	Coronary reactivity testing findings					Pregnancy details	
			LVEDP (mmHg)	CFR	CBF increase to Ach (%)	LAD diameter response to Ach (%)	LAD diameter response to nitro (%)	Gestational Age (weeks)	Birth Weight (g)
1	34	G5P3A1	10	1.6	40%	11%	31%	37	2265
2	35	G4P2A1	11	2.3	58%	11%	17%	35	2665
3	36	G4P2A1	12	2.1	89%	17%	21%	40	3286
4	37	G3P1A1	17	3.2	10%	-8%	12%	39	3969
5	29	G2POA1	10	2.6	-8%	0%	10%	40	3560

# **A Population Level Epidemiological Study of Peripartum Cardiomyopathy in Olmsted County, Minnesota**

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## **Objective**

Conduct an epidemiological study on peripartum cardiomyopathy (PPCM) using the Rochester Epidemiology Project (REP) to estimate incidence and study risk factors, outcomes, and survival.

## **Methods**

Retrospective cohort study using data from REP abstracted from medical records for females aged 15-55 with a confirmed diagnosis of PPCM between 1970-2014.

## **Results**

49 cases of PPCM were confirmed. The mean age was 28 (range 15-44), 75.5% were white, 18.3% of African descent (6/9 were migrants from Africa), 2.1% was Filipino, 2.1% American Indian, and 2.1% Hispanic. 47% of the cases were primiparous. Common co-morbidities included mental health conditions (55%), allergies (50%), migraines (44%), and a history of infections (68%) with 47% having an infection during the index pregnancy. Of the 57 infants born to PPCM cases, the sex for 56 was available and showed 57% ( $n=32$ ) were female and 42% ( $n=24$ ) male. 54% of cases were diagnosed with hypertensive disorders of pregnancy with the most common diagnosis being preeclampsia. Mean left ventricular ejection fraction at diagnosis was 32% (range 10-45%). Of 46 patients with follow-up, 43 eventually regained normal cardiac function with an average time to recovery of 14 months (range 1 month to 12 years), 2 had continued cardiac dysfunction, and 1 patient died. There were no transplants and no use of cardiac devices.

## **Conclusion**

49 Cases of PPCM were identified from the REP. Previously known risk factors of hypertensive disease of pregnancy and African decent were confirmed while infection during pregnancy, history of mental health diagnosis, migraines, allergies, and sex of the offspring were identified as new potential risk factors requiring further study.

**Funding sources:** None.

# **Predictors of Early and Delayed Recovery in Peripartum Cardiomyopathy: A Prospective Study of 52 Patients**

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## **Background**

Predictors of early or delayed recovery are unclear in peripartum cardiomyopathy (PPCM). Therefore, we aimed to assess the prognostic value of serial assessment of clinical, echocardiographic and biochemical markers in patients with PPCM.

## **Methods**

Fifty-two consecutive women with PPCM were enrolled in this prospective study. Each patient underwent transthoracic echocardiography, B-type natriuretic peptide (BNP) and C-reactive protein (CRP) measurement at admission, and every 3 months. Early recovery was defined as resolution of heart failure at 6 months post-diagnosis, delayed recovery was defined if the length of time required for recovery of left ventricular function was longer than 6 months, and persistent left ventricular dysfunction (PLVD) was defined as an ejection fraction of less than 50 % at the end of follow-up.

## **Results**

Thirty patients (57.7%) recovered completely, 10 died (19.2%), and 12 (23.1%) had PLVD. There were no significant differences in baseline BNP and CRP values between patients who recovered completely and who did not recover. However, patients with complete recovery were more likely to have a higher left ventricular ejection fraction, smaller left ventricle end-systolic dimensions at baseline, and lower CRP and BNP levels at follow-up. Elevated levels of BNP and CRP on follow up at 3 and 6 months were associated with nonrecovery. Third and 6th month BNP values were significantly lower in patients with rapid recovery, compared to patients with delayed recovery. Bromocriptine therapy was also associated with early recovery.

## **Conclusions**

Persistent elevation of plasma CRP and BNP levels at follow-up portend a slower response or non-recovery in patients with PPCM. Bromocriptine therapy was an independent predictor of early recovery.

# Diagnostic Accuracy of Doppler Echocardiography in Detecting Significant Pulmonary Hypertension in Pregnancy

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## Background

Pulmonary hypertension (pHTN) during pregnancy has significant morbidity and mortality. Transthoracic echocardiography (TTE) is the usual screening modality but validity in pregnancy has been assessed only rarely and questioned in other settings with elevated cardiac output such as liver disease.

## Objective

Assess Doppler estimated PASP by TTE in comparison with “gold standard” right heart catheterization (RHC) in pregnant women.

## Methods

We performed a meta-analysis of pregnant patients undergoing both TTE and RHC including 3 UIC patients and 49 measurements from 46 patients in the 2 previously published studies<sup>1,2</sup> which provide primary data. Total N = 52. We compared accuracy using two different cut-off points: any degree of elevated PASP  $\geq 30$  mmHg and PASP  $\geq 40$  mmHg which correlates with World Health Organization mean PASP of 25 mmHg. Definitions: Normal PASP 2) plus estimated RA pressure.

## Results

See Tables 1 and 2. Using a 30 mm cut-off, TTE accurately classified degree of pHTN in 50% of patients, overestimated pHTN in 33% and underestimated pHTN in 17%. Women with moderate pHTN were most likely to have a change in severity class (82%). Sensitivity of TTE for any degree of pHTN was high, 90%; However, specificity was low (15%). Specificity could be improved by using a cut-off point of 40 mmHg without loss in sensitivity. Specificity was highest in the setting of severe pHTN.

## Conclusion

TTE is a reasonable screening tool for pHTN, although RHC may provide more accurate stratification, especially for women with moderate pHTN.

Penning S. et al. AJOG. 2001; 184(7): 1568

Wylie BJ et al. JPerinatMed. 2007; 35(6): 497

# Prosthetic Heart Valve Thrombosis in Pregnancy- An Experience at Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan.

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## Background

Prosthetic heart valve thrombosis (PVT) is a rare complication, with an estimated incidence of 0.1% to 5.7% per patient-year. However, during pregnancy, a pro coagulant state that increases the risk of PVT up to 10%.

## Method

In last one year total of 345 pregnant patients managed with cardiac problems in Rawalpindi Institute of Cardiology.

## Results

Rheumatic Heart disease was the main bulk ( n=186 , 54%) and 96(28%)with metallic valve replacement making it second commonest problem in pregnancy. Outcome showed 67(69%) patients delivering vaginally, 23(24%) having a lower segment caesarean section and 6(6.5%) patients having complication of stuck metallic valve. Five of patients with stuck metallic valve had mitral valve replacement where as one had Double valve replacement. All patients were on warfarin except one who was taking haprin as anticoagulant. The mean Age, parity and gestational age of patients was 24 years  $\pm$  SD3.46, 1.67 $\pm$ 0.816 and 7.5 $\pm$  2.16 weeks respectively. INR ranged from 0.8 to 1.2 with mean of 1.01 $\pm$ 0.16. Mitral valve was involved in all cases with the mean gradient of 20.50 mmHg  $\pm$ 2.881. Four patients had a successful thrombolysis with streptokinase with one patient developing a hemorrhagic ovarian cyst and one having bleeding per vaginum which was managed conservatively. All pregnancies continued uneventfully .Two of patients presented with incomplete abortion. Patients with incomplete abortion were managed with a high risk dilatation and curettage followed by thrombolysis with streptokinase as per protocol. One of the patient expired even after successful dilatation and curettage and thrombolysis.

## Conclusion

Prosthetic heart valve thrombosis remains to be a challenging nightmare in pregnancy. A multidisciplinary approach in a dedicated cardiac facility improves outcome. Streptokinase as thrombolysis have shown promising results.



# Transposition of the Great Arteries in Pregnancy: Outcomes of a Combined Cardiac & Obstetric Ante-Natal Clinic

**Gemma Ulivi**<sup>1</sup>, Kate English<sup>2</sup>, Sarah Winfield<sup>1</sup>, James Oliver<sup>2</sup>, Alex Simms<sup>2</sup>, Thomas Everett<sup>1</sup>

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<sup>2</sup>*Leeds Teaching Hospitals NHS Trust, Leeds, UK*

## Background

There is an increasing number of women of child bearing age with transposition of the great arteries (TGA). We are aware that pregnancy poses a great physical test to these women. However, the data on specific outcomes for this population group is limited.

## Objective

We assessed the maternal & neonatal outcomes of pregnancy in women with transposition of the great arteries (TGA) attending our specialist multidisciplinary cardiac antenatal clinic in a large UK tertiary centre.

## Methods

Data was collected retrospectively for all pregnant women with TGA between January 2014 & December 2016. Data collected included diagnosis, complications, medication, fetal anomalies, echo findings, mode of delivery and birthweight.

## Results

We identified 14 pregnant women (age 23-34 years) with TGA. 2 women had congenitally corrected TGA, 6 had a Senning operation, 4 had an arterial switch procedure and 1 had a Mustard Operation. Left ventricular function was normal in 2 women, mildly impaired (45-50%) in 4 women, moderately impaired (30-44%) in 7 women and severely impaired (30%) in 1 woman. There was right ventricular impairment in 1 woman.

8 Women were on LMWH and 2 were started on bisoprolol.

6 Women required caesarean sections for obstetric indications and there were 8 vaginal births (-1 forceps and 7 NVD). There was only one delivery prior to 37 weeks and this was in the individual with severely impaired LV function; it was a caesarean section at 34+1 week's gestation.

Median birthweight (+/-IQR) was 3172.5g (+/-860g).

## Conclusion

The results of this combined ANC show good maternal and neonatal outcomes. These are largely related to relatively stable and sustained ventricular function. These women are at high risk however successful vaginal deliveries are possible with multi-disciplinary input in specialist units.

# Neuraxial Anesthesia for Vaginal and Cesarean Delivery in Patients with Complex Congenital Heart Disease: A Case Series

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## Background

Parturients with complex CHD are at increased risk for maternal and neonatal complications. These patients present multiple anesthetic challenges related to changes in preload, pulmonary vascular resistance, afterload, and cardiac output in the physiologically-fluid environment surrounding childbirth.

## Objective

To describe the anesthetic management and outcomes of parturients with complex congenital heart disease and educate anesthesiologists, cardiologists, and obstetricians as to the safety of neuraxial techniques in these patients.

## Methods

A retrospective cohort analysis of parturients with complex CHD - repaired or uncorrected - undergoing either vaginal delivery (VD) or cesarean section (CS) over a 7yr period was performed. Demographic data, cardiac pathology, previous cardiac surgeries, pre-pregnancy and peripartum cardiac status, pregnancy course, nature of delivery, method of anesthesia/analgesia, operative details, and postoperative course were examined. Zahara Pregnancy Cardiovascular Risk Scores were also determined.

## Results

Data from 54 parturients was collected (Table 1). Thirty (56%) underwent CS and 23 (43%) underwent VD. Neuraxial anesthesia was performed for 100% of the VD – as detailed in Table 1. Only 3 (6%) CS patients had general anesthesia whereas, the remainder underwent combined spinal-epidural (n=5), dural puncture-epidural (n=6), slowly-dosed epidural (n=9), or spinal (n=7) anesthesia. Cardiac complications (n=10) included: arrhythmia (n=3); worsening heart failure symptoms (n=4); and cardiogenic shock (n=3). All patients with cardiac complications had a Zahara Risk Score  $\geq 2.5$ .

In our practice, the anesthetic management is modified specifically for these complex patients. Technique, testing, dosing, and monitoring are all patient specific. Additionally, fluid management (permissive bleeding, etc.) is tailored to the clinical situation. Uterotonic choice also occurs with consideration of the underlying cardiac pathology.

## Conclusion

This study provides details of anesthetic management of this complicated patient population in whom evidence-based practice recommendations are lacking. We suggest that with a carefully executed approach, neuraxial anesthesia is associated with favorable maternal and neonatal outcomes.

Patient	Age	Pathology	Surgery/History	Intrapartum/Perinatal Echo/angiography/Findings	New/Care Heart Association (NHA) Functional Classification	Gravidity	EGA	Delivery Type	Anesthesia	Intensive Care Unit (#Days)	Neonatal or maternal complications	Zehra score	Cepres score
30	20	Thoracic aorta	left aortoplastic shunt at age 6 weeks followed by aortic shunt at 12 months, then aortic age 4 that was closed age 12, just status aortitis with patent aortic age 9	24wk BSA: liver 40%, stomach aortic valve unroofed VSD with bidirectional shunting, hypoplastic LV	III	01	22	dilation & C&S with indopipril, buspirone, ketamine, and fentanyl	0	0	neonatal total anemia	4.75	2
31	21	Secondary AAO, membranous VSD, patent ductus arteriosus	patent aortic valve at age 11 months, cardiomegaly, pulmonary pathologically demonstrated severe subacute obstruction due to her ventricular septal aortic and moderate aortic regurgitation as the unroofed portion of her subacute obstruction, resection of the ventricular septal defect patch, as well as aortic and mitral valve/plasticity immediately thereafter	24wk BSA: liver 40.5%, position left superior vena cava, non-coronary cusp of the aortic valve is hypoplastic, aortic valve area 0.9 cm <sup>2</sup> , moderate aortic valve insufficiency, dilated mitral valve insufficiency, dilated mitral valve	II	01	27.2	PTCS	0P2	1	none	5.25	1
32	20	closed transposition of the great arteries with secondary pulmonary hypertension	urgently corrected age unknown, pre-aortic placement for complete heart block age unknown	22wk BSA: liver 42%, cardiomegaly, dilated aortic valve, coronary AV in the systemic ventricle, severely reduced RV systolic function, severely enlarged RV cavity size, severe RV hypoplasia, dilated valve in the systemic aortic valve, dilated regurgitant, dilated mitral valve, mitral valve in the pulmonary aortic valve, moderate mitral valve regurgitation	III	01	24.1	PTCS	0P2	12	cardiogenic shock requiring inotropic support	5.5	5
33	20	Double inlet, discordant, secondary left aortic arch aorta	pulmonary artery banding age 10, bilateral/bidirectional Glenn procedure age 15, Fenest procedure age 18	22 wk BSA: liver 33%, aortic valve showed moderate regurgitation, VSD is present and communicates the LV to the aortic arch, venous flow noted in the pulmonary artery from the Fenest procedure and the bilateral Glenn shunt	III	01	24.1	PTCS	0P2	5	leakage of clamping and fluid overload	5.5	2
34	24	Pulmonary stenosis		24wk BSA: liver 40%, dilated pulmonary valve, severe RV hypoplasia, mild and obstructive severe valvular and subvalvular pulmonary stenosis, moderate pulmonary valve insufficiency	I	01P0010	28.6	PTCS	0P2	1	none	0	0

# **Persistence of Abnormal Strain after Left Ventricular Ejection Fraction Recovery in Peripartum Cardiomyopathy**

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## **Background**

Peripartum cardiomyopathy (PPCM) is defined as unexplained heart failure in a previously healthy woman between the last month of pregnancy and up to 5 months postpartum, with LV ejection fraction (LVEF)  $\leq 45\%$  and an evaluation consistent with idiopathic non ischemic cardiomyopathy. It is known that, although not related to mortality, global longitudinal strain (GLS) is impaired in patients with PPCM. Longitudinal relationship between abnormal strain and future cardiomyopathy is to be determined.

## **Objective**

To determine an association between LVEF and strain in patients with PPCM.

## **Methods**

Using ICD-10 codes, 78 patients with PPCM were identified from 1990-2015. Patients older than 18 years, with no history of cardiac disease, LVEF  $\leq 45\%$  and idiopathic non ischemic cardiomyopathy were included. Those with valvular or coronary artery disease (50% stenosis of a major vessel or positive stress test), septicemia, ongoing drug or alcohol abuse, history of chemotherapy or chest radiation, other cardiomyopathy or HIV were excluded. From the 53 patients included, 23 had 2-3 echocardiograms dated after 2009, compatible with the Philips QLAB 10.2 software for strain analysis. 10 were excluded due to poor image quality and 1 patient was excluded after heart transplant. --- Regional segments and GLS were analyzed at diagnosis, and at 6 and 12 months.

## **Results**

The patients' mean age was 29.9 years (range 20-39). The mean initial LVEF was 27.5% (range 10-45), and were treated with medical therapy. 1 patient required IABP, 2 patients were placed on LVAD, and improved after explanation (due to vaginal bleeding). Despite normalization of LVEF in 76% of cases (10/13) at 1 year, GLS persisted abnormal in all cases.

## **Conclusion**

Being GLS a more sensitive method to identify subclinical myocardial dysfunction, persistence of abnormal GLS even after LVEF recovery in PPCM patients might be related to abnormal baseline cardiomyopathy and predisposition to recurrence.

## **Multidisciplinary Management of Pregnant Women With Infective Endocarditis**

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### **Objective**

The incidence of infective endocarditis (IE) during pregnancy has been reported to be 1 in 8,000 deliveries with serious calculated maternal and fetal mortality rates, that demands the improvement of approaches to managing patients.

### **Aim**

Evaluation of multidisciplinary approach efficacy in perinatal management in women with infective endocarditis.

### **Results**

There were 5 women with IE of mitral valve diagnosed within pregnancy and postnatal period. Four of them were diagnosed with IE after delivery – cesarean section (3) and vaginal delivery (1). The open-heart surgeries with mechanical prosthesis implantation were performed. One case of IE diagnosed in 11 weeks of pregnancy, the patient categorically refused to terminate her pregnancy. Clinical and laboratory data indicated the severity of the infectious process. In the pharynx were found *Str.parasanguinis* 10<sup>7</sup> and *Staph.aureus* 10<sup>6</sup>, in blood specimen- *Enterococcus faecalis*. The start therapy with meropenem changed to taigecycline and linezolid after obtaining data on the sensitivity of the flora to antibiotics. After joint consultation by cardiosurgeons and obstetricians it was decided to perform the reconstructive surgery of mitral valve in midtrimester with prophylactics of miscarriage and preterm birth. The result of the surgery was successful, intraoperative esophageal echocardiography testified minimal residual mitral regurgitation. The pregnancy resulted in the delivery of healthy female newborn by elective CS in 39 weeks of pregnancy. The 6-month and 10 month follow –up revealed no disorders in patterns of child growth and maternal state.

### **Outcome**

The evident data testify better operative results and lower incidence of valve-related complications in mitral valve reconstruction in patients with acute IE. There is a great need for international consensus for management of cardiac surgical diseases in pregnancy. The multidisciplinary approach for perinatal management of pregnant with heart disease testifies about positive results both for woman and child.

## **Women with Congenital Heart Disease (CHD) in Pregnancy- A Combined Cardio-Obstetric Clinic Report from Cape Town, South Africa**

**Liesl Zuhlke**<sup>1,2,3</sup>, Heidi Weberruß<sup>4</sup>, Ayesha Osman<sup>5</sup>, Johan Baard<sup>3</sup>, Feriel Azibani<sup>3</sup>, Tony Lachman<sup>5</sup>, John Anthony<sup>5</sup>, Karen Sliwa<sup>3</sup>

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<sup>5</sup>*Division of Obstetrics and Gynaecology, South Africa*

### **Background**

Congenital heart disease (CHD) is a leading cause for maternal death in western countries, little is known about developing countries like South Africa. Grown-up congenital heart disease (GUCH) patients are at high risk for cardiac failure and cardiovascular complications during pregnancy. In 2014, we described the spectrum of cardiac disease in a combined cardio-obstetric clinic in a tertiary maternity centre in Cape Town.

### **Objective**

To quantify the presentation, clinical assessment and outcomes of GUCH patients in this clinic.

### **Methods**

Women were enrolled either during pregnancy or within 6 months postpartum after ethics approval. Patients were classified according to the modified WHO classification of maternal risk in pregnancy with clinical assessments including echocardiography at baseline and follow-up.

### **Results**

There were 239 women (mean 28.5±5.9yrs) included in the total cohort. The GUCH cohort constituted an ethnic mix of 29% black African, 59% mixed, 9.6% white, and 2.4% other. In total, 84 (35.1%) had CHD (most common were Ventricular and Atrial Septal Defects: 32% and 14% respectively, Tetralogy of Fallot 11%, Pulmonary Stenosis and Coactation of the Aorta 6%). Almost two-thirds (64.1%) had previous cardiac surgery. Frequency of heart failure and complications during pregnancy did not differ significantly from women without CHD. There were no deaths recorded. There were two neonatal deaths (2.3%) and two mid-trimester miscarriages.

### **Conclusion**

We report excellent maternal and neonatal outcomes for GUCH patients. As the GUCH population increases, the impact on tertiary obstetric services will be felt, highlighting the need for interdisciplinary medical teams to ensure good outcomes.

# **Inherited Left Ventricular Non-Compaction in Spontaneous Monochorionic Diamniotic Twin Pregnancy**

**Joann Hale**<sup>1</sup>, Rajeswari Parasuraman<sup>1</sup>, Andrew Curry<sup>2</sup>, David Howe<sup>1</sup>, Samantha Fitzsimmons<sup>2</sup>

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<sup>2</sup>*Cardiovascular & Thoracic Specialist Services Divisio, UK*

## **Background**

Pregnancy in Left Ventricular Non-Compaction (LVNC) can increase the risk of heart failure, arrhythmias and systemic embolic events. LVNC carries an autosomal dominant trait and incomplete penetrance. This case study demonstrates the importance of including genetic inheritance within pre-pregnancy counseling, multidisciplinary care and early detection of clinical deterioration in women with LVNC. Whilst we believe this is the first case study with identified genetic testing with an alteration in gene MYH7.

## **Case Report**

A 27year old female with an antenatal diagnosis of LVNC was referred from out of region at 23weeks gestation with spontaneous mono-chorionic diamniotic twins. Transthoracic echocardiogram (TTE) demonstrated dilated trabeculated left ventricle (LV) 5.6cm with severe LV systolic dysfunction EF 20-25%. Pre-pregnancy EF was 30-35%. Medical therapy was up-titrated and patient remained NHYA II. 27weeks gestation she presented with a nocturnal cough. Clinical examination demonstrated elevated jugular venous pressure, worsening mitral and tricuspid regurgitation, peripheral oedema and S<sub>3</sub>. Repeat TTE demonstrated deterioration in LV function EF 10-15%. She was admitted for intravenous diuretics and medication optimisation. Fetal echocardiogram confirmed the monochorionic twins had inherited left ventricular non-compaction. She was delivered at 30 weeks by caesarean section in cardiac theatres under general anaesthetic with vascular access in place to allow prompt E-CRP if required. Postnatally, the patient returned to NYHA II and LV EF 20-25%. Day 1 TTE of the twins confirmed LVNC with identical appearances to their mother. Genetic testing identified an alteration in gene MYH7 (c.3908GC p.(Arg1303Pro)). This genetic change has not been seen before in other individuals.

## Contraception for Women with Cardiac Disease

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### Introduction

Increasing numbers of women of reproductive age are affected by cardiac disease, partly because more children with congenital heart disease (CHD) are surviving to adulthood and also because of the rise in obesity and unhealthy behaviours. Pregnancy is associated with haemodynamic, haemostatic and metabolic alterations that increase cardiovascular risk, particularly in women with cardiac disease. Choosing the most appropriate contraceptive for women with cardiac disease requires consideration of the level of risk if the woman become pregnant; the method's efficacy; the risks associated with administration and long-term use; the contraceptive benefits; and the woman's own personal choice. Provision of information and effective contraception are therefore of paramount importance to avoid pregnancy or to allow time for preconception planning and minimisation of pregnancy risks. This study aims to evaluate the choice and current use of contraceptive method in women with heart disease treated at UNIFESP.

### Results

We monitored 58 cardiac patients in our family planning service. Of these, 36.8% had valvular heart disease, 14% congenital heart disease, 14% ischemic heart disease, 12.3% myocardiopathies and 22.8% other heart diseases (Marfan syndrome, mucopolysaccharidosis with pulmonary hypertension and arrhythmias). The main contraceptive choice for this patient profile was Cu-IUD (31.6%), followed by depot medroxyprogesterone acetate (26.3%), - LARC (57.9%) - combined hormonal contraception (14.0%), progestogen-only pill (8.8 %), sterilization (7.0%), condom (5.3%), LNG-IUS (1.8%) and none (5.3%).

### Conclusion

Cardiopathy patients should be encouraged to perform family planning and the choice of contraceptives should be individualized according to the eligibility criteria. LARC (Cu-IUD + depot medroxyprogesterone) accounted for almost 60% of all methods. We have plans to increase use of Levonorgestrel IUD in this population, especially in anticoagulated patients.



# Hemodynamic Changes of Doppler Gradients during Pregnancy and the Influence of Ventricular Function in Patients with Valvular Heart Disease

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## Background

Patients with valvular heart disease (VHD) have an increased risk of complications during pregnancy. During pregnancy, physiological increase of plasma volume and cardiac output could affect Doppler gradients used for the assessment of VHD. Currently, little is known about the course of Doppler gradients during pregnancy, hampering interpretation during pregnancy.

## Objective

We aimed to study the course during pregnancy of Doppler gradients used for the assessment of VHD.

## Methods

The cohort comprised 66 pregnant patients enrolled in the prospective ZAHARA studies or evaluated by an identical protocol who had pulmonary stenosis (PS), a prosthetic pulmonary valve (PPV), aortic stenosis (AS), or a prosthetic aortic valve (PAV). The control group comprised 46 healthy pregnant women. Echocardiography was performed preconception, during pregnancy and 1 year postpartum. Peak gradient, mean gradient, left ventricular ejection fraction (LVEF) and right ventricular function (RVF; TAPSE) were assessed.

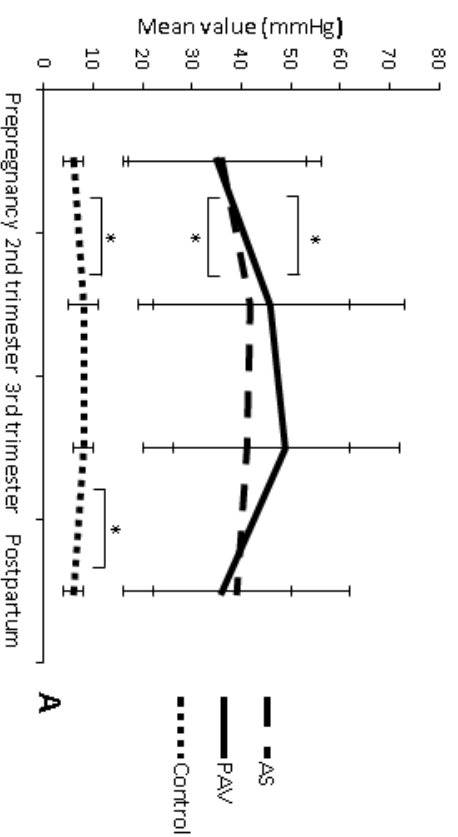
## Results

Figure 1 presents the course of the peak Doppler gradients, including correction for heart rate which increased significantly during pregnancy ( $p < 0.001$ ). Peak and mean gradients increased significantly ( $p < 0.0125$ ) during pregnancy compared to preconception in patients with aortic VHD (calculated valve area unchanged) and in controls, but not in patients with pulmonary VHD. Preconception and postpartum gradients were comparable in all groups. LVEF was normal (50%) in all groups at all moments. TAPSE was significantly lower at all moments in patients with pulmonary VHD compared to patients with aortic VHD and controls ( $\leq 20$ mm vs.  $\geq 23$ mm,  $p < 0.001$ ).

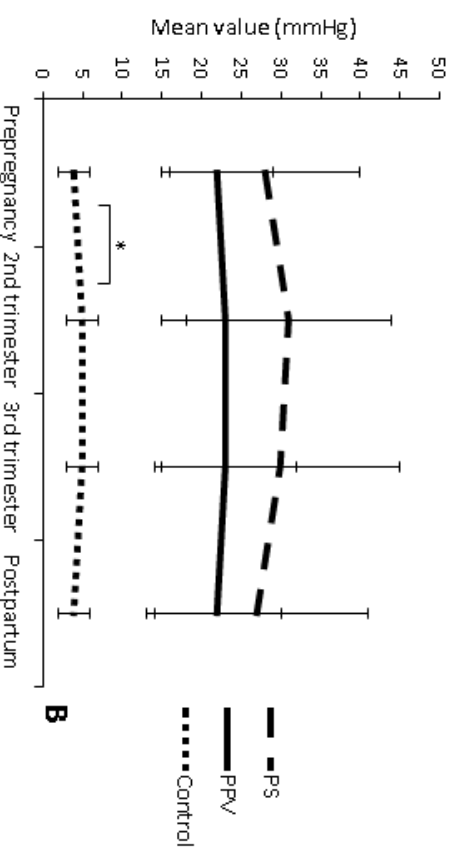
## Conclusion

Physiological changes during pregnancy lead to increased Doppler gradients during pregnancy in patients with aortic VHD. The same expected changes were not found in patients with pulmonary VHD, probably caused by reduced RVF. Therefore, evaluation of RVF during pregnancy is of importance to prevent possible underestimation of the degree of stenosis in these patients.

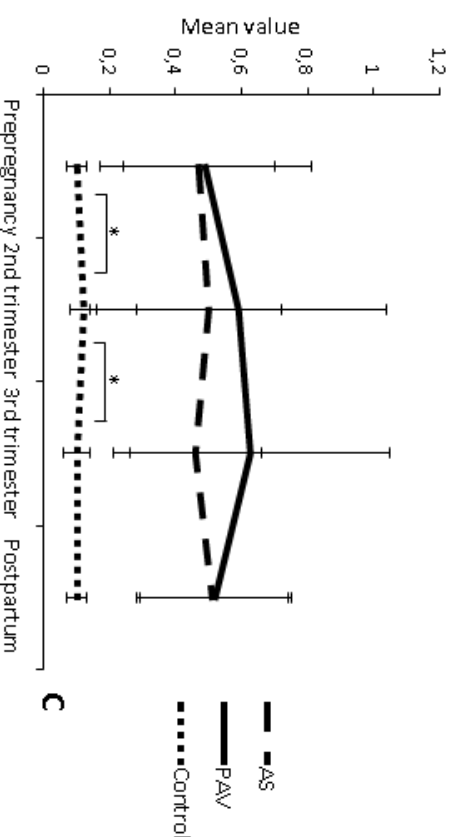
### Peak gradient aortic valve



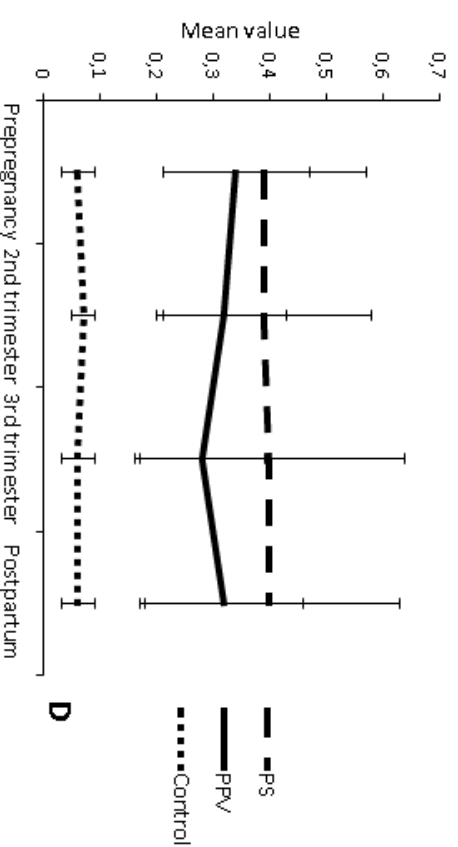
### Peak gradient pulmonary valve



### Peak gradient/heart rate aortic valve



### Peak gradient/heart rate pulmonary valve



**Figure 1.** The course of the peak Doppler gradients of patients with aortic VHD (A), pulmonary VHD (B) and controls. The course of peak gradient/heart rate of patients with aortic VHD (C), pulmonary VHD (D) and controls. VHD; valvular heart disease. \* Significant difference between the specific time points.

# Management of Severe Cardiac Disease in Pregnancy - The Experience of a Single Unit in a Resource Limited Setting

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## Background

Cardiac disease contributes significantly to the maternal mortality in Sri Lanka, where the rate is around 32.5/100,000 live births. The Obstetric Unit of the Colombo University is a referral center for severe cardiac disease. 2D echocardiography is freely available, but catheterization studies are done only with interventions. A minority conceal severe cardiac disease for social reasons.

## Objective

To describe to outcomes of pregnancy women with severe heart disease, in a resource limited setting.

## Method

Data was collected prospectively from May 2014 for a period of 3 years.

## Results

There were a total of 113 women. Twenty were in World Health Organization (WHO) class 3 and 88 in WHO Class 4, while five had ischemic heart disease, which is not in the WHO classification. Forty-eight had rheumatic (42%) and 41 (36%) congenital heart disease. Five had prosthetic valves, four primary pulmonary hypertension, four cardiomyopathy and five peripartum cardiomyopathy. Twenty-nine had severe, 20 moderate and 29 mild pulmonary hypertension (PHT), while 36 did not have PHT. Therapeutic terminations were performed in 15. Fifty-four delivered by elective LSCS while 12 had emergency LSCS. Nine delivered by spontaneous vaginal delivery while 21 had assisted vaginal deliveries (Forceps 11, ventouse 10). There were 89 live births, 4 stillbirths and 2 neonatal deaths. Twenty-five had their labor induced. The majority (73; 64.6%) received intensive care during delivery (Mean 3 days, Range 1 to 19days) while 23 received HDU care. Nine underwent percutaneous Trans mitral commissurotomy, while one underwent triple valve replacement at 28weeks (She delivered an I.U.D. at 33 weeks). There were three cerebrovascular events. There were three maternal deaths (all from WHO category 4). One had superimposed H<sub>1</sub>N<sub>1</sub> and another had concealed the pregnancy.

## Conclusion

Adherence to protocols could improve outcomes in women with severe heart disease in resource poor settings.

# Peripartum Anesthetic Management in Patients with Left Ventricular Hypertrabeculation

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## Background

Left ventricular hypertrabeculation (LVHT) is an uncommon cardiomyopathy characterized by extensive trabeculations and a two-layered structure of the left ventricular myocardium. The three major sequelae from this deformity are heart failure symptomatology, arrhythmias, and thromboembolism. Current literature describing anesthetic management of this patient population during pregnancy is limited.

## Objective

Describe the peripartum care and anesthetic management during delivery of parturients with LVHT.

## Methods

The records of women admitted for delivery at Mayo Clinic, Rochester, Minnesota between January 2001 and October 2017 were searched using free-text query for terms relating to LVHT. Echocardiograms were reviewed and only patients meeting Jenni criteria<sup>1</sup> were included. Data pertaining to cardiac function, labor, delivery, and post-partum management were abstracted from the medical record.

## Results

Six deliveries occurred in patients with LVHT. Antepartum complications include heart failure exacerbation and ventricular tachyarrhythmias. Two had normal spontaneous vaginal deliveries and 1 had forceps assisted delivery. Three had cesarean delivery (CD). Indications for CD include breech presentation and refractory non-sustained ventricular tachycardia (VT). Analgesic management of vaginal deliveries included epidural (n=1), nitrous oxide (n=1), and unmedicated (n=1). Anesthesia for CD included spinal (n=1), combined-spinal epidural (n=1), and general (n= 1). Invasive monitoring was required in 2 cases. ICU monitoring immediately postpartum was utilized in 3 cases. Postpartum complications include prolonged intubation, refractory VT, IABP insertion, and persistence of an LVEF 35% with subsequent ICD placement. Four women required anticoagulation during pregnancy with no development of VTE throughout the peripartum process.

## Conclusion

LVHT complicates obstetric anesthetic management due to increased risk for arrhythmias and heart failure exacerbation in the peripartum period. Successful vaginal and cesarean delivery has been shown using multiple anesthetic techniques. Close monitoring intrapartum and postpartum should occur based on the patient's cardiac function as well as symptomatology.

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# **Echocardiographic Findings in Women with and without Cardiovascular Overload Symptoms During Physiological Pregnancy**

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## **Background**

Up to 60 % of women in the third trimester of considered to be physiological pregnancy complain of dyspnea, edema of the legs and/or decreased exercise tolerance. The problem remains whether the degree of cardiac adaptation to volume overload in pregnancy is relevant to these symptoms.

## **Objective**

To compare echocardiographic parameters of left and right ventricle (LV, RV) function in women in the third trimester of physiological pregnancy experiencing or not dyspnea, edema of the legs and/or decreased exercise tolerance.

## **Methods**

Symptoms were assessed with a specially designed questionnaire. Clinical assessment included detailed medical history and patient's examination. All patients had echocardiographic assessment of RV and LV systolic and diastolic parameters.

## **Results**

90 women were assessed. Median age was 30.5 years. Median pregnancy duration was 32 weeks. Mean pre-pregnancy weight was 63.7kg and at examination 75.5kg. Extensive fatigability was the most common complaint (71.1%). Patients had no other know causes of these symptoms. LV and RV ECHO parameters were within normal rage in all subjects except for left atrium area and pulmonary truncus width. Echocardiographic parameters were similar between subjects complaining or not of lower limb edema or dyspnea. However women with edema had higher examination weight (79 vs 74.2kg;p=0.019) despite no preexisting difference (p=0.229). Women with extensive fatigability had larger end-systolic left ventricular diameter (LVESD; 32.9 vs 30.6mm; p=0.041), thinner intraventricular septum diameter (12.4 vs 13.6mm;p=0.001) and shorter deceleration time of E wave (203 vs 166ms;p=0.018). They also had higher heart rate (89 vs 80 beats per minute; p=0.007). In women with impaired exercise tolerance larger LVESD (32.7 vs 30.4mm;p=0.044) higher pre-pregnancy (64.9 vs 57.3;p=0.016) and examination weight (76.6 vs 69.4;p=0.036) were observed.

## **Conclusion**

There are echocardiographic differences between pregnant women experiencing or not cardiac symptoms. Pre-pregnancy weight and pregnancy weight gain influence the occurrence of cardiac symptoms.

## The Effects of Bisoprolol During Pregnancy

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### Background

Pregnant woman with cardiovascular disease (CVD) may need beta- adrenergic blockers that are associated to foetal growth restriction (FGR). Bisoprolol is a selective antagonist of Beta 1 receptor: there are few of data about bisoprolol exposure during pregnancy.

### Objective

The aim of the current study is to analyse maternal and neonatal outcome in pregnant woman with cardiovascular disease treated with bisoprolol.

### Methods

We retrospectively reviewed 198 pregnant women with CVD followed at the “Città della Salute e Scienza Hospital”, Turin, Italy, between 2014 and 2017.

We identified 26 women with singleton pregnancies treated with bisoprolol for at least 2 weeks before delivery. Maternal outcomes were examined, including gestational age, delivery mode, cardiovascular events. Cardiovascular events were defined as arrhythmia or heart failure. Neonatal outcomes examined included birth weight, Apgar score. Neonates were classified according their weight at birth in AGA (Adequate for gestational age), SGA (small for gestational age) and LGA (large for gestational age).

### Results

The delivery was vaginal in 58,3%. Delivery complications were reported in 26,7%. At birth median gestational age was 37.9 for cases and 38.7 for controls (p=0.018). The median birthweight was 2665g for cases and 3050g for controls (p=0.002). The median birthweight centile is 19.5 for cases and 43 for controls (p=0.003); there were 10 SGA in cases and 14 controls (p=0.019). The length of therapy with bisoprolol negatively correlate with the birthweight centile, there is also a significant difference in median weeks of therapy when SGA infants were compared with no SGA infants in the cases group. No significant FGR difference between 2 groups was noted. No bradycardia and hypoglycemia was reported.

### Conclusions

In our study infants of women treated with bisoprolol during pregnancy had an higher risk to be SGA, although this finding is not related to an increase in FGR.

## **Dilated Cardiomyopathy in Pregnancy: A Retrospective Data Analysis.**

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### **Background**

Pregnancies in women with dilated cardiomyopathies (dCMP) are considered to entail high risks for complications and maternal death. This disease causes arrhythmia, stroke, heart attack and heart failure. However, only few data are currently available to characterize the history and predict the outcome of pregnancy, delivery and postpartum course.

### **Methods**

In this retrospective data analysis, we report on 11 pregnancies in nine women with dilated cardiomyopathies who were treated by a multidisciplinary team of obstetricians, cardiologists, cardiothoracic surgeons and anesthesiologists at our hospital from 2006 until 2017.

### **Results**

Four women (five pregnancies) had mildly reduced left ventricular (LV) function, with uncomplicated pregnancies and deliveries (Tbl.1).

Major cardiac complications and premature deliveries occurred in three women (four pregnancies), see Tbl.2. Case No 5 with suspected non-compaction right ventricle underwent orthotropic heart transplantation three months after delivery. Case No 7 had toxic cardiomyopathy after polychemotherapy including anthracyclines for osteosarcoma.

Two cardiac deaths occurred. Case No 8 suffered a cardiac arrest in the early second trimester (NYHA II, EF: 40%, 1459 pg/ml NT-proBNP before pregnancy). Case No 9, a 23 year old Primigravida with NYHA III before pregnancy had termination of pregnancy at GA 17 for cardiac decompensation. Her cardiac function did not improve; she died two months after termination whilst on waiting list for heart transplantation (NYHA IV, EF 25%, NT-proBNP 6857 pg/ml before termination).

### **Conclusions**

Our study group is characterized by a high rate of maternal complications. Reliable markers for counseling and risk assessment are lacking. More data are needed for this heterogeneous group of women.

# Pregnancy Management and Outcomes in Pregnant Women with Rheumatismal Mitral Stenosis

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## Backgrounds

Rheumatic heart disease (RHD) is common in developing countries. Rheumatic mitral valve disease is a great threat for pregnant women. In this study, we aimed to evaluate the fetomaternal outcomes of pregnancy with rheumatismal mitral stenosis (MS).

## Methods

In a prospective study, the outcomes of pregnancies in 54 consecutive patients with a diagnosis of rheumatismal mitral valve (MV) were evaluated. The study population included patients with mitral stenosis (MS) who may undergo percutaneous MV valvulotomy or followed up medically. All women were examined by transthoracic echocardiography at the beginning of pregnancy.

## Results

Patients' mean age was  $32.1 \pm 5$  years. The mean of left ventricular ejection fraction, mitral valve gradient, mitral valve area (MVA), pulmonary arterial pressure (PAP) at baseline were  $52.6 \pm 4.6\%$ ,  $8.4 \pm 2.9$  mmHg,  $1.2 \pm 0.2$  cm<sup>2</sup>, and  $43.4 \pm 16.3$  mmHg, respectively. The mean of fetal birth weight, gestational age at birth were  $2754.7 \pm 507.6$  gr and  $37.5 \pm 1.2$  weeks, respectively. The rate of male babies were 46.3% and 5.6% of pregnancies were twin. The rate of previous histories of abortion and intra uterine fetal death (IUFD) were 5.6% and 18.5%, respectively. The frequency of normal right ventricular (RV) function, mild, mild to moderate, and moderate RV systolic dysfunction were 46.3%, 13%, and 1.9%, respectively. Twenty cases (37%) underwent percutaneous transcatheter mitral commissurotomy (PTMC). We performed PTMC for patients with symptoms more than class II in spite of beta blocker and low dose diuretic therapy, for those with MVA less than 1 cm<sup>2</sup>, ladies with PAP more than 60 mmHg at resting echocardiography or individuals with twin pregnancies. Only one patient had therapeutic abortion. The rate of maternal intensive care unit (ICU) stay, maternal prolonged hospital stay, and atrioventricular nodal reentry tachycardia were 31.5%, 3.7%, and 1.9%, respectively. We recommended 24 to 48 hours ICU stay even in the case of asymptomatic state after delivery. Maternal intensive care unit length of stay was  $37.89 \pm 18.44$  hours. Complications in babies, including oligohydramnios, intra uterine growth retardation (IUGR), and preterm death were 3.7%, 1.9%, and 3.7%, respectively. The mean of PAP was significantly higher in patients with complications compared with those without them ( $56.7 \pm 15.6$  vs.  $41.5 \pm 13.5$  mm Hg,  $P = 0.031$ ). 3 of our cases have twin babies, all of them had received infertility treatments with in vitro fertilization (IVF) without any previous of cardiac disease. All of them underwent PTMC and successfully delivered by caesarian section.

## Conclusion

Women with a diagnosis of moderately severe or severe rheumatismal MS can tolerate pregnancy at the cost of development of complications in the minority of cases but this needs continuous precise follow up and timely interventions. Also we recommend a heart exam before infertility treatments that have the risk of multiple pregnancies.



## **Safety and Use of Levonorgestrel Intrauterine Device and Progesterone-Derived Subcutaneous Implants in Women with Heart Disease**

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### **Introduction**

Preconception assessment and contraception is considered a key point in women at reproductive age with heart disease. In 2007, we created a specific gynecology-cardiology preconception clinic to address patients' risk after careful cardiologic and gynecologic assessment. Contraceptive methods are discussed with patient.

### **Methods and results**

Since March 2007 to July 2017 a total of 630 patients have been referred and followed up at the joint. A total of 12% received subcutaneous implant (n=77) and/or levonorgestrel intrauterine device (LNG-IUD). Eighteen% was on oral anticoagulation. Modified WHO risk of pregnancy and contraception was considered at least 3 in 58% of patients (n=44). Subcutaneous implants were offered after a trial of oral progesterone-only-minipill, especially to young nulliparous women. LNG-IUD were offered to patients after vaginal delivery, and in patients with hypermenorrhea on oral anticoagulation. Complete gynecological assessment including hysterometry was performed before insertion of LNG-IUD.

### **Results**

During follow up 47 LNG-IUD and 30 subcutaneous implants were inserted for the first time, 8 patients received another LNG-IUD or implant. No side effects during insertion were observed. Patients with severe pulmonary arterial hypertension or considered at high risk if vagal reaction occurred, insertion was performed with an anaesthesia environment. During a mean follow up of 32 months, (range 2-76) no cardiac or thrombotic complications were observed. 3 implants were retired due to irregular bleeding (one patient 2 months after implant and 24 months in 2 others). Two LND-UID were retired, one patient felt uncomfortable and in other patient mobilization was observed in routine control without perforation. Patients on oral anticoagulation referred to LND-IUD insertion due to hypermenorrhea presented substantial decrease of menses. No infection was observed. No pregnancies were reported.

### **Conclusions**

LNG-IUD and subcutaneous implants are safe methods in high risk patients with heart disease. Use of safe contraception should be expanded in this patient population.