Making Sense of Heart Disease in Pregnancy

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Disclosure
• No real or potential conflict of interest to disclose.
• No off-label, experimental or investigational use of drugs or devices will be presented.

Objectives
• At the end of the presentation, the participant will be able to:
  – Define, and list facts and statistics related to heart disease in pregnancy.
  – Evaluate heart disease and understand general principles, preconception though postpartum
  – Differentiate types of heart disease during pregnancy.

References
Additional references at end of presentation

Type of Heart Disease During Pregnancy

Cardiology Alphabet Soup

ASD/VSD
PDA
Coarctation
TOF
NYHA
HCM
PPCM
CHD
CAD
HF
LVEF

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<table>
<thead>
<tr>
<th>Acronym</th>
<th>What it stands for</th>
<th>What it is</th>
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<tbody>
<tr>
<td>ASD</td>
<td>Atrial septal defect</td>
<td>Opening between atria</td>
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<tr>
<td>VSD</td>
<td>Ventricular septal defect</td>
<td>Opening between ventricles</td>
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<tr>
<td>Coart</td>
<td>Coarctation of the aorta</td>
<td>Narrowed aorta arch</td>
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<tr>
<td>TOF</td>
<td>Tetralogy of Fallot</td>
<td>Opening between ventricles; aorta, right ventricle, pulmonary valve</td>
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<tr>
<td>TGV</td>
<td>Transposition of great vessels</td>
<td>Aorta and pulmonary artery are reversed</td>
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<tr>
<td>AS/AR</td>
<td>Aortic or mitral valve stenosis/regurgitation/insufficiency</td>
<td>Valve obstruction or leakage</td>
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<tr>
<td>MS/MR</td>
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<tr>
<td>PDA</td>
<td>Patent ductus arteriosus</td>
<td>Left over fetal connection of aorta to pulmonary artery</td>
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<tr>
<td>CHD</td>
<td>Coronary or congenital heart disease</td>
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<tr>
<td>CAD</td>
<td>Coronary artery disease</td>
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<tr>
<td>HF</td>
<td>Heart failure</td>
<td>Systolic/diastolic dysfunction</td>
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<tr>
<td>LVEF/EF</td>
<td>Left ventricular ejection fraction</td>
<td>Squeeze of heart muscle</td>
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<tr>
<td>PPCM</td>
<td>Peripartum cardiomyopathy</td>
<td>Peripartum HF</td>
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<tr>
<td>HCM</td>
<td>Hypertrophic cardiomyopathy</td>
<td>Thick heart muscle</td>
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<tr>
<td>TAVR</td>
<td>Transcatheter aortic valve replacement</td>
<td>Percutaneous vs. surgical</td>
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Heart Disease During Pregnancy

- 1–4% of pregnancies in the U.S. are affected
- Congenital HD has replaced rheumatic
- Advancing maternal age adds other risks
- High risk patients require specialized team approach

Changing Demographics

- Delayed childbearing age
- Rise of obesity, hypertension, diabetes in young women
- Survival of women with CHD into adult years
  - Advances in treatment allowing for the option of pregnancy

Mortality During Pregnancy

- Proportion of pregnancy-related deaths attributed to HD has increased
  - Cardiomyopathies
  - Pulmonary HTN
  - Aortic dissection
  - Myocardial infarction

Objectives
Preconception Counseling

- For all women with HD
- Begin early, at sexual maturity
  - Evaluate and discuss risk of pregnancy
  - Discuss birth control
  - Discuss ways to optimize maternal status
  - Discuss potential decline in cardiac status
  - Identify impediments to tertiary care
  - Plan care with OB and cardiology team

Role of Preconception Counseling

- An individualized approach is best.
  - Can include genetic testing/counseling
    - Cardiomyopathy, Marfan syndrome
- Identifies patients in whom pregnancy is contraindicated, prior to pregnancy

What’s Important?

- Assess maternal risk
- Maternal risk depends on complexity of primary cardiac lesion AND if residual lesions or other clinical sequelae exist (HF, arrhythmias, cerebrovascular events)
  - WHO risk score

What’s Important? (continued)

- Assess fetal risk
  - Maternal risk is the major determinant
  - Spontaneous abortion/intrauterine demise
  - Preterm birth
  - Other neonatal events
    - Small for gestational age
    - Respiratory syndromes
    - Interventricular hemorrhage
    - Neonatal death

Risks to Fetus

- Maternal and neonatal events are highly correlated.
  - Neonatal complications up to 30%
  - Neonatal mortality 1–4%

Risks to Fetus (continued)

- Risk of adverse events
  - Baseline NYHA Class II or higher or cyanosis
  - Maternal left heart obstruction
  - Smoking during pregnancy
  - Multiple gestation
  - Oral anticoagulants during pregnancy
  - Mechanical valve prosthesis
Risks to Fetus (continued)

- Abnormalities to fetal growth and development
  - Low birth weight
  - Prematurity
  - Death

Genetic Counseling

- Offer to women with CHD
  - Genetic screening tests
  - Pre-, post-testing counseling
  - 3 generation family history
  - Maternal and paternal evaluation
  - Autosomal dominant conditions have high transmission risk ~ 50%
  - Syndromes: Marfan, Holt-Oram, Noonan, Alagille, CHARGE, 22q11.2 microdeletion, Williams

Cardiac Evaluation Prepregnancy

- The foundation to assess the risk
  - History and physical exam
  - NYHA classification
  - Labs: CBC, CMP, thyroid, BNP, UA
  - Echo, ECG, cardiopulmonary testing

Risk Assessment and Management

- Preconception risk assessment
- History and physical exam (repairs, sequelae, comorbidities)
- Functional class, cardiopulmonary exercise test
- Genetic counseling
- Review medications
- Review contraception options

Determine WHO Risk

<table>
<thead>
<tr>
<th>WHO risk</th>
<th>Risk description</th>
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<tbody>
<tr>
<td>Maternal risk factors</td>
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</table>

| Maternal risk factors | (PDA=Patent ductus arteriosus; MV=mitral valve; ASD=Atrial septal defect; VSD=Ventricular septal defect; PV=Pulmonary valve; TOF=Tetralogy of Fallot; LV=Left ventricular; CHD=Congenital heart disease; NYHA=New York Heart Association; LVEF=Left ventricular ejection fraction; PPCM=Peripartum cardiomyopathy |

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<thead>
<tr>
<th>Risk</th>
<th>Description</th>
<th>Maternal Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Slight risk of morbidity, no mortality risk</td>
<td>• Uncomplicated mild pulmonary stenosis, PDA, MV prolapse • Successfully repaired lesions: ASD, VSD, PDA, anomalous PV drainage • Atrial or ventricular, isolated ectopic beats</td>
</tr>
<tr>
<td>II</td>
<td>Moderate morbidity risk, small mortality risk</td>
<td>If otherwise well/uncomplicated • Unoperated ASD, VSD • Repaired TOF • Most arrhythmias</td>
</tr>
<tr>
<td>WHO Risk</td>
<td>Risk Description</td>
<td>Maternal Risk Factors</td>
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</table>
| II-III   | Moderate risk for morbidity and mortality | - Mild LV impairment  
- Hypertrophic cardiomyopathy  
- Native/tissue valve disease  
- Marfan syndrome (w/out aortic dilation)  
- Repaired coarctation |
| II       | Moderate risk for morbidity and mortality | - Fontan circulation  
- Complex congenital heart disease  
- Other complex CHD  
- Aortic dilation 40-45 mm (Marfan’s)  
- Aortic dilation >50 mm (bicuspid AV) |
| IV       | Severe morbidity risk, extremely high mortality risk | - PAH  
- Severe LV dysfunction (LVEF <30%, NYHA Class III-IV)  
- Previous PPCM with residual LV dysfunction  
- Severe mitral stenosis, aortic stenosis  
- Aortic dilation >45 mm (Marfan’s)  
- Aortic dilation >50 mm (bicuspid AV)  
- Native severe coarctation |

Predictors of Events
- Poor functional class  
  - NYHA class II to IV or cyanosis  
- Previous cardiac event  
- Left heart obstruction  
  - Mitral or aortic stenosis  
- Left ventricular systolic dysfunction  
  - Ejection fraction <40%

When is pregnancy not advised?

<table>
<thead>
<tr>
<th>Valve disease</th>
<th>Pregnancy not advised in women with:</th>
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<tr>
<td>Severed mitral and aortic valve disease</td>
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</tbody>
</table>
Mechanical prosthetic valves if effective anticoagulation not possible  
Failing Fontan circulation  
O2 saturation <85%  
aortic diameter of family history of premature aortic dissection |

Cardiac Evaluation Prepregnancy
- Planning based on WHO category  
  - Medication strategy  
  - Optimization strategy  
  - Monitoring plan  
  - Delivery plan  
  - Referral plan
When is pregnancy not advised?

### Valve disease

- Complex congenital heart disease
- Pregnancy not advised in women with:
  - Severe mitral and aortic valve disease
  - Mechanical prosthetic valves if effective anticoagulation not possible

- Pregnancy not advised in women with:
  - Significant ventricular dysfunction
  - Severe atrioventricular valve dysfunction
  - Failing Fontan circulation
  - O₂ saturation <85%

### Pulmonary hypertension

- Pregnancy not advised in women with:
  - Significant ventricular dysfunction
  - Poor left ventricular function
  - Failing Fontan circulation
  - O₂ saturation <85

### Aortopathy

- Pregnancy not advised in women with:
  - Marfan syndrome (MFS)
  - Bicuspid aortic valve (BAV)
  - Turner syndrome
  - Rapid growth of aortic diameter of family history of premature aortic dissection

### Risk-based Strategy

**Low risk**
- Evaluate at regional CHD center
- Maternal-fetal medicine OB
- Each trimester
- Delivery plan at regional center

**Moderate risk**
- Evaluate at regional center by cardiologist
- Maternal-fetal medicine OB
- Each trimester
- Delivery plan at regional center

**High risk**
- Manage exclusively at regional center for prenatal care and delivery
- Coordinated care, if geographic or financial challenges

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When Pregnant: Prenatal risk assessment in pregnant patient

- Clinical stable: Review meds stop teratogenic
- Clinically unstable or high risk: Monitoring and delivery plan with CHD and MFM team
  - Monitor echos each trimester
  - Discuss risk of morbidity and mortality
  - Consider transfer to tertiary care center
  - Multidisciplinary team monitoring and delivery plan
Evaluating a Pregnant Patient

- ECG, Holter or other ambulatory monitoring for palpitations, syncope
- Echocardiogram
- CXR: Discouraged unless indicated
  - Shield baby
- Exercise stress test (V02)
  - Assess cardiopulmonary reserve

Evaluating a Pregnant Patient (continued)

- Exercise stress echo
  - Assess for myocardial ischemia
- MRI
  - Maternal safety, unclear about fetal safety
  - Avoid gadolinium or at least wait until 2nd–3rd trimester

CT/VQ scan
- Depends on gestational age and dose of radiation
- Only used if other testing is inadequate
- Cardiac catheterization
- Minimize radiation exposure
- Shorten fluoroscopy time, shielding

Medication FDA Classification in Pregnancy

<table>
<thead>
<tr>
<th>No evidence of risk</th>
<th>B</th>
<th>No evidence of risk</th>
<th>C</th>
<th>No controlled studies, consider if risk &gt;benefit</th>
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<tr>
<td></td>
<td></td>
<td>Sildenafil</td>
<td>Metoprolol, Carvedilol, Nifedipine, Verapamil/diltiazem, Captopril, Clonidine, Hydralazine, Furosemide, Spironolactone, Heparin/enoxaparin, Digoxin, Epi/NorEpi/Levo/Dopa, Adenosine</td>
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<td>HCTZ, Epoprostenol, Nitroprusside, Nitroglycerin, Clopidogrel, Argatroban, Fondaparinux, Sotalol</td>
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<thead>
<tr>
<th>D</th>
<th>Evidence of fetal risk</th>
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<tbody>
<tr>
<td></td>
<td>Lisinopril (2nd–3rd trimesters)</td>
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<tr>
<td></td>
<td>Atenolol</td>
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<tr>
<td></td>
<td>Amiodarone</td>
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<thead>
<tr>
<th>X</th>
<th>Evidence of fetal risk</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>Amiodarone</td>
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<td></td>
<td>Warfarin</td>
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Medication FDA Classification in Pregnancy

<table>
<thead>
<tr>
<th>Classification</th>
<th>Example Drugs</th>
</tr>
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<tbody>
<tr>
<td>No evidence of risk</td>
<td>Epoprostenol, Nitroglycerin, Nitroprusside</td>
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<tr>
<td>Potential risk, not confirmed</td>
<td>Nitroglycerin, Nitroprusside, Argatroban</td>
</tr>
<tr>
<td>No controlled studies, consider if risk &gt;benefit</td>
<td>Sildenafil, HCTZ</td>
</tr>
<tr>
<td>Evidence of fetal risk</td>
<td>Epoprostenol, Nitroglycerin, Nitroprusside, Argatroban, Fondaparinux, Sotalol</td>
</tr>
<tr>
<td>Fetal risk &gt;benefit, contraindicated in pregnancy</td>
<td>Warfarin, Metoprolol, Carvedilol, Nifedipine, Verapamil/diltiazem, Captopril, Hydralazine, Furomide, Spironolactone, Heparin/ENOXAPARIN, Digoxin, EP/NEF/D/LEVO/LEU/ADENOSINE, LISA</td>
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</tbody>
</table>
Antepartum Care

1st trimester

- Review cardiac history, preconception plan
- Evaluate any new symptoms
  - Shortness of breath, palpitations, edema
  - Anticoagulation plan
- Physical exam
  - Remember usual changes with pregnancy
  - Attention to new murmurs, arrhythmia, evidence of heart failure

2nd trimester

- Greatest degree of hemodynamic changes
- Repeat echocardiogram
- Fetal echocardiogram
- Review plan for labor, delivery, postpartum
  - Distribute to the team
  - Team meeting for high risk, after week 23–24
  - Contingency plan
    - Admission, early delivery

3rd trimester

- Individualize frequency of visits
- Monitor for signs of normal pregnancy vs. decompensation
- Finalize plans and contingencies
- Antibiotic prophylaxis

Fetal Assessment

- Fetal echocardiogram in 19th–22nd week of pregnancy
- Refer if fetal CHD is discovered to discuss prognosis, management
  - Maternal-fetal medicine specialist
  - Pediatric cardiologist
  - Neonatologist
  - Geneticist

Normal Intrapartum Changes

- During labor
  - Increased HR, CVP, CO
  - Position matters!
    - Lateral recumbent position increases CO by 22%
    - Supine position can compress inferior vena cava and reduce venous return
    - Causes lightheadedness, fetal decelerations

Consideration During Labor

- Attempt vaginal delivery if stable
  - Facilitate with forceps and/or vacuum assist, PRN
- Epidural anesthesia
  - Decreases sympathetic stimulation and reduces myocardial oxygen consumption
Consideration During Labor (continued)

- Monitor maternal systemic BP, telemetry, oximetry
  - Consider hemodynamic monitoring when appropriate (central access)
- Continuous fetal HR monitoring

C-Section?

- No consensus
- **Reserved** for usual obstetric indication or critical condition of mother and/or baby

C-Section? (continued)

- **Considered** if
  - On oral anticoagulation in preterm labor
  - Preexisting mechanical heart valve(s)
  - Marfan syndrome + aortic dilation
  - Acute or chronic aortic dissection
  - Intractable or acute HF
  - Severe AS
  - Severe PHTN

Normal Changes Post Delivery

- Reduction in CO within an hour to 24 weeks
- Reduction of BP within an hour to 2 weeks
- 500 cc of autotransfusion after placenta delivery, may not be tolerated

Normal Changes Post Delivery (continued)

- Blood loss
  - 600 cc vaginal; 1000 cc C section
  - Results in tachycardia and decreased stroke volume

Keys to Postpartum Care

- Early post partum time is often a time of acute decompensation
- Monitor for HF symptoms
- Can need telemetry and or intensive care
- Monitor fluid balance
- Prevent thromboembolism with meticulous leg care, support stockings, and early ambulation

Keys to Postpartum Care (continued)
Contraception Recommendations

• Low dose OCPs (20 mcg estradiol)
  – May be safe if low thromboembolism risk
  – Consider initiating 3–4 weeks post partum
  – Estrogen-only; avoid during lactation
  – Contraindicated in prior thrombosis, cyanotic lesions, elevated hepatic enzymes

• Progesterone-only
  – Less thromboembolic risk

• IUDs
  – Safe and effective
  – Consider 4 weeks postpartum to avoid bacteremia, hemorrhage

Contraception Recommendations (continued)

• Surgical sterilization
  – Tubal ligation
  – Fallopian tubal occlusion
  – Vasectomy

Multidisciplinary Management

• The team
  – High risk OB and perinatology
  – Cardiology
    • General, interventional, HF, EP
  – CT: Surgery, intensivists, anesthesia
  – Advanced practice and RNs
  – Social work
  – Genetic counselors
  – Care coordinators

Goals of Management

• Optimizing hemodynamics
• Relief of symptoms
• When possible continuation of chronic therapies
• Treatment of precipitating factors
  – Anemia, arrhythmias, thyroid disorders

Goals of Management (continued)

• Methods for achieving these goals include
  – Treatment of pulmonary congestion with diuretics
  – Afterload reduction
  – Control of hypertension
Case Study #1

- 32 yo with a hx of congenital pulmonary stenosis, in early pregnancy
  - Surgical valvuloplasty at 3 months and
  - Subsequent severe PI
  - Underwent Melody valve placement in the native outflow tract
  - Complicated by MSSA endocarditis with valve destruction, prolonged hospitalization, ICU stay

Case Study #1 (continued)

- Had eventual surgical valve replacement
  - Treated with nafcillin, rifampin and 2 weeks of levofloxacin on 8/24
  - Unfortunately, developed embolic phenomenon to the lung.
- She is fortunately recovered impressively well and delivered a healthy boy at 38 weeks.

Congenital HD

- Risk of recurrence of CHD in offspring
- In general population, risk is 8 per 1,000
- If mother has CHD, risk is 5 in 100
- Benefits to genetic counseling

CHD Maternal Risks

<table>
<thead>
<tr>
<th>Low maternal risk</th>
<th>Moderate risk</th>
<th>High risk</th>
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<td></td>
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<tr>
<td>Low maternal risk</td>
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<tr>
<td>Small VSD</td>
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<tr>
<td>ASD</td>
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<tr>
<td>Bicuspid aortic valve w/out stenosis, regurgitation, aortic dilation</td>
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<tr>
<td>Repaired coarctation of aorta</td>
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<tr>
<td></td>
<td>Prepregnancy NYHA Class 2+, maternal cyanosis</td>
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<tr>
<td></td>
<td>Systolic dysfunction; LVEF &lt;40%</td>
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<tr>
<td></td>
<td>Prepregnancy MS, valve gradient &lt;2 cm^2 or AS</td>
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<tr>
<td></td>
<td>Valve gradient &lt;1.5 cm^2</td>
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<td></td>
<td>Preconception CVA, arrhythmia, pulmonary edema</td>
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<tr>
<td></td>
<td>Marfan syndrome</td>
<td></td>
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<tr>
<td></td>
<td>Eisenmenger syndrome</td>
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<td></td>
<td>Pulmonary HTN</td>
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**CHD Maternal Risks**

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- Moderate risk
  - Repaired TOF
  - Anatomic RV as systemic ventricle
  - Mild MS, AS
  - Cyanotic lesions w/out pHTN
  - Fontan circulation
  - Uncorrected coarctation of aorta

- Prepregnancy NYHA Class 2+, maternal cyanosis
- Systolic dysfunction; LVEF <40%
- Prepregnancy MS, valve gradient <2 cm² or AS, valve gradient <1.5 cm²
- Preconception CVA, arrhythmia, pulmonary edema
- Marfan syndrome
- Eisenmenger syndrome
- Pulmonary HTN

**Risk of HF with CHD**

- **Lower risk**
  - Isolated ASD, VSD
  - Coarctation of aorta after treatment
  - Tetralogy of Fallot after surgery

- **Higher risk**
  - Pulmonary HTN
  - Eisenmenger syndrome
  - Severe AS or other valvular disorders
  - Single ventricle or other cyanotic HD

**CHD Considerations**

<table>
<thead>
<tr>
<th>Type</th>
<th>Consideration</th>
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<tbody>
<tr>
<td>ASD</td>
<td>Usually well-tolerated during pregnancy, depends on other factors</td>
</tr>
<tr>
<td>VSD</td>
<td>Larger ones have risk of HF, arrhythmias, pHTN (often require pressors and close monitoring during pregnancy)</td>
</tr>
<tr>
<td>PDA</td>
<td>If pHTN and cyanosis present, reversal of L-R Shunt with pressors may be needed</td>
</tr>
<tr>
<td>Coarctation</td>
<td>BB used to treat HTN and prevent aortic dissection</td>
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**CHD Considerations (continued)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Consideration</th>
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<tr>
<td>TOF</td>
<td>Preconception repair is preferred. Cyanosis is associated with increased risk.</td>
</tr>
<tr>
<td>Complex CHD</td>
<td>Transposition of great vessels: Repair preconception is preferred. Tricuspid atresia Single ventricle: After Fontan, pregnancy controversial</td>
</tr>
<tr>
<td>Eisenmenger syndrome</td>
<td>Avoid pregnancy, offer termination, 40% M&amp;M</td>
</tr>
</tbody>
</table>
Extracardiac Fontan Procedure

Coarctation

Considering Repair Prior to Pregnancy
- Left heart obstruction
- Right to left shunts
- Examples
  - Closure of patent ductus arteriosus
  - Closure of ASD, VSD with significant shunting
  - Ebstein’s anomaly

Type of Heart Disease During Pregnancy

Case Study #2
- 32 yo female comes in for preconception counseling
- PMH
  - G3P3 had progressive HF symptoms (NYHA Class III) with last pregnancy.
  - Echo: Moderate to severe MS with severe PHTN, LVEF 63%
Case Study #2 (continued)

- What do you recommend?
  - Mitral valvuloplasty performed, successful result
  - Delivery and postpartum care was unremarkable.
  - Post delivery echo: Mild-moderate MS
  - Remained NYHA Class II
- ...wait, there’s more...

Case Study #2 (continued)

- Presented pregnant at 25 weeks with 4th pregnancy
- During pregnancy
  - Progressive NYHA class IV symptoms
  - Echo
    - Increased MS and PHTN

Case Study #2 (continued)

- Now what do you recommend?
  - Bedrest, used wheelchair
  - Diuretics
- Near-term delivery uneventful
- Symptoms returned to baseline after delivery

Case Study #2 (continued)

- Echo: Stable function and reduced MS mild-moderate
- Consideration of valve replacement on hold
- Recommend no further pregnancies, contraception plan with OB

Valvular Issues During Pregnancy

- Infrequent, ~1% incidence
- In developed world, mostly congenitally acquired
- Other forms
  - Rheumatic, myxomatous, previous endocarditis, bicuspid aortic valve
- Tend to have favorable prognosis if managed appropriately

Valvular Lesions

- Aortic or mitral stenosis
  - Assess for bicuspid aortic valve
  - Moderate to severe MS poorly tolerated during pregnancy
Valvular Lesions
(continued)

• Aortic or mitral regurgitation
  – Decreased risk compared to stenotic lesions
  – Decreased SVR lessens regurgitant volume
  – Severe regurgitation with LVD is poorly tolerated.

Valvular Lesions
(continued)

• Pulmonary valve stenosis or regurgitation
  – Severe PI with low EF
    • Independent predictor of poor maternal outcomes
    – Severe PS can lead to increased arrhythmias and RV failure.

Risk of Various Valvular Issues

• Low maternal/fetal risk
  – Asymptomatic AS with mean valve gradient <50 mm Hg and normal systolic function
  – AR or MR, NYHA Class I–II, normal systolic function

Risk of Various Valvular Issues
(continued)

• High maternal/fetal risk
  – Severe AS
  – AR NYHA Class III or IV
  – MS, NYHA Class II–IV
  – AV, MV disease with pHTN and pulmonary pressure >75% of systemic pressure

• Low maternal/fetal risk (cont.)
  – MVP, no MR or mild MR with normal systolic function
  – Mild to moderate MS without severe pHTN
  – Mild-moderate PV stenosis

• High maternal/fetal risk (cont.)
  – AV, MV disease with systolic dysfunction
  – Maternal cyanosis
  – Any valve disease with NYHA Class III–IV

Valvular Disease

• Insufficiency/Regurgitation
• Stenosis
Management
Valve Disease During Pregnancy

• “Short, pain-free labor”
  – Vaginal delivery to minimize hemodynamic changes and blood loss
• Continuous monitoring
  – Blood pressure, ECG, oxygen
  – Fetal monitoring

Management
Valve Disease During Pregnancy (continued)

• Hemodynamic monitoring in severe cases
• Antibiotic prophylaxis
  – Prosthetic valve or un repaired cyanotic lesions

Case Study #3
Transcatheter Procedure

• 22 yo with hx valvuloplasty age 9 years for bicuspid AV, otherwise healthy, active
• At 15 weeks gestation, presented with dyspnea, CP, near syncope
• Multidisciplinary, multinational review
• Imaging to help valve selection

Case Study #3
Transcatheter Procedure (continued)

• Reducing risks
• Anticoagulated with ASA
• Delivered normal baby, 38 weeks

Treatment of Valvular Heart Diseases

<table>
<thead>
<tr>
<th>Condition</th>
<th>Treatment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral stenosis</td>
<td>Percutaneous balloon valvuloplasty, 2nd trimester Vaginal delivery with epidural anesthesia</td>
</tr>
<tr>
<td>Chronic mitral regurgitation</td>
<td>Asymptomatic: No treatment Med Rx for systolic dysfunction (diuretics, digoxin, hydralazine, nitrates)</td>
</tr>
<tr>
<td>Aortic stenosis</td>
<td>Ideal intervention pre pregnancy Follow closely: Risk of HF, arrhythmia, ischemic events</td>
</tr>
<tr>
<td>Chronic aortic regurgitation</td>
<td>Vasodilators: Hydralazine, diuretics and nifedipine Hemodynamic monitoring during L&amp;D</td>
</tr>
<tr>
<td>Mechanical prosthetic valves</td>
<td>Warfarin: Risks to fetus &gt;5 mg/day LMWH: Dosing per antifactor Xa levels</td>
</tr>
</tbody>
</table>
Anticoagulation Management with Prosthetic Valves

Note: Little evidence of newer oral anticoagulants during pregnancy. Direct thrombin inhibitors, factor Xa inhibitors cross the placenta have not had study during pregnancy.

Case Study #4

- 36 yo female 22 weeks pregnant
- HPI: Presents to ED, progressive LE edema and dyspnea at rest
- PMH: Previously healthy – G2, P1. Abx 6 wks ago for cough

Diagnostics

- Echo
  - EF 10%, LVIDD 6.2, mod-severe MR
- ECG
  - Sinus tach, HR 120 BPM, NSIVCD, QRS 136
- Labs
  - BNP 927, ALT 195 units/L, AST 70 units/L, others WNL
- Uterine US
  - Placenta previa
- Fetus
  - Viable

Now what?

Case Study #4 (continued)

- Exam: Dyspneic during regular conversation, BP 127/95 mm Hg, HR 120 bpm, JVD ~10 cm H20, HSM, pitting edema
- What do you do?

- Treatment
  - IV furosemide (Lasix)
  - Digoxin
  - Isosorbide
  - Enoxaparin
Case Study #4 (continued)

- Risk assessment: HF and placenta previa
  - 50% mortality if she has therapeutic abortion
  - 70% mortality if she proceeds through pregnancy
- Multidisciplinary team planned delivery at 28 weeks

Case Study #4 (continued)

- Outcome
  - In cath lab with many specialists
  - PA catheter placed
  - Intubated
  - Impella
  - C-section, baby fine
  - Clinical deterioration
  - Emergent LVAD
  - Successful transplant

Cardiomyopathies

- Peripartum
- Idiopathic dilated cardiomyopathy
- Familial
- Hypertrophic
- Arrhythmic
- Others
  - Prior viral infection, HIV infection or drug-induced cardiomyopathy

Conditions that Increase the Risk of HF during Pregnancy

- Peripartum and other Cardiomyopathies
  - Congenital
  - Valvular

Risk of HF Syndrome

Heart Failure and Pregnancy

- Approach varies
  - HF as a chronic condition
    - Considering pregnancy
      - Preconception counseling
    - Currently pregnant
      - Medication adjustment
      - Monitoring for decompensation
  - HF as an acute and new presentation
**Symptoms**

**Are they normal?**

- In normal pregnancy
  - Shortness of breath
  - Activity intolerance
  - Peripheral edema
- When are symptoms out of proportion?
  - Use of BNP

**Monitoring a Pregnant Patient with HF**

- Mild disease
  - Monthly antenatal visits
- Moderate to severe disease
  - Every 2 weeks until 28 weeks then weekly
- Echos every trimester, monthly in 3rd trimester, and PRN

**Management**

**HF During Pregnancy**

- Afterload reduction
- Preload reduction
- Inotropy (Increased contractility of heart)

- Nitroglycerine and Hydralazine
- Diuretic and low dose nitrates
- Beta – blockers
- Calcium Channel Blockers
- Digoxin


**Peripartum Cardiomyopathy**

- **Diagnosis**
  - LVSD
    - EF<45%
  - No prior cardiac history
  - Onset
    - Last month of pregnancy to 5th postpartum month

**Peripartum Cardiomyopathy (continued)**

- **Treatment**
  - Same as for other forms of LVSD
  - Consider pregnancy and lactation
  - Timing of ICD
    - Consider waiting longer to assess recovery

**PPCM Treatment: Medications**

<table>
<thead>
<tr>
<th>Meds during pregnancy</th>
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<th>Meds TBD</th>
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<tbody>
<tr>
<td>BB-B1 selective: Metoprolol</td>
<td>BB-B1 selective: Metoprolol</td>
<td>Bromocriptine</td>
</tr>
<tr>
<td>Hydralazine/nitrates</td>
<td>Hydralazine/nitrates</td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>Digoxin</td>
<td></td>
</tr>
<tr>
<td>LMWH/UFH</td>
<td>LMWH/UFH</td>
<td></td>
</tr>
<tr>
<td>Diuretics</td>
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<td></td>
</tr>
<tr>
<td>Avoid ACE/ARB, warfarin (avoid DOACs)</td>
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<td></td>
</tr>
</tbody>
</table>

PPCM Treatment: Medications

Meds during pregnancy
- BB-B1 selective: Metoprolol
- Hydralazine/nitrates
- Digoxin
- LMWH/UFH
- Diuretics

Meds during breast feeding
- BB: Metoprolol (caution with newborns)
- ACEI: Captopril,enalapril,benazepril
- Thiazide and loop diuretics
- Digoxin
- Warfarin
- Avoid ARBs, MRA

Meds for contraception
- Nonestrogen (etonogestrel) implant
- Copper IUD
- Levonorgestrel-releasing IUD
- Avoid estrogen/progestin combo

Meds TBD
- Bromocriptine
- Avoid ACE/ARB, warfarin (avoid DOACs)

Type of Heart Disease During Pregnancy
- Congenital
- Valvular
- Cardiomyopathy
- Coronary

Case Study #5
- 36 yo female
- PMH: Gravida 2, para 1. 1 week post delivery. No cardiac history
- HPI: Presented with chest pain, taken to cath lab for angiogram, extensive dissection of LAD, emergent ECMO
  - EF <20%, large scar, no viability
  - Unable to wean ECMO
- What are her options?

Coronary Artery Issues
- Myocardial infarction is rare.
  - 1:10,000 pregnancies
- Repaired TGA
  - At risk of ischemic events
- Coronary dissection, vasospasm occur
- Highest mortality with MI late 3rd trimester

Coronary Artery Issues (continued)
- Increased incidence due to increased maternal age
- Risk factors
  - Smoking, family history, DM, hypertension, preeclampsia, OCP use, cocaine use
- Pregnancy adds to risk
  - Increase in total cholesterol, LDL, triglycerides, and lower HDL
CAD Diagnosis

• Diagnosed per usual means
  – Symptoms
  – ECG
  – Biomarkers

CAD Treatment

• Consider fetal effects
• Low dose ASA
• BB safe, caution with nitrates and CCB due to avoid maternal hypotension
• Relative contraindication to thrombolytics
• PTCA and CABG have had favorable outcomes.

CAD Treatment (continued)

• Delay delivery 2–3 weeks after MI
• Minimize cardiac workload during L&D
• Vaginal delivery, assisted during prolonged 2nd stage
• Epidural, manage HTN, potential hemodynamic monitoring

Summary

• Identifying women with HD in childbearing years is important for preconception planning.
• Assessing a mother and baby’s risk for adverse outcomes is important in all scenarios.

Summary (continued)

• During pregnancy, attention should be paid to medications, surveillance monitoring and delivery plan using a multidisciplinary team.
• Each type of HD carries risk, treatments and special considerations.

References

• Canobbio et al. (2017) “Management of Pregnancy in Patients with Complex Congenital Heart Disease” Circ
• Hodson et al. (2016) “Transcatheter Aortic Valve Replacement During Pregnancy” Circ Interventions
References (continued)


References (continued)


Questions?

End of Presentation
Thank you for your time and attention.
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Risk Assessment and Management

Preconception risk assessment

History and physical exam (repairs, sequelae comorbidities)

Functional class
Cardiopulmonary exercise test

Testing:
ECG, Echo, Labs

Genetic counseling

Review medications

Review contraception options

WHO

Determine

Risk
When Pregnant: Prenatal risk assessment in pregnant patient

- Review meds
  - Stop teratogenic

Clinically stable
- Monitoring and delivery plan with CHD and MFM team
- Monitor echos each trimester

Clinically unstable or high risk
- Discuss risk of morbidity and mortality
- Consider termination
- Consider transfer to tertiary care center
- Multidisciplinary team monitoring and delivery plan
**CENTRAL ILLUSTRATION** Balancing the Risks of Anticoagulation in Pregnancy

<table>
<thead>
<tr>
<th>Consideration for Anticoagulation in Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy is a prothrombotic state with nearly a 5-fold increased risk of VTE.</td>
</tr>
<tr>
<td>Choice of anticoagulant must balance maternal risk with fetal risk.</td>
</tr>
<tr>
<td>VKAs are safest for the mother, and complications to the fetus are dose-dependent.</td>
</tr>
<tr>
<td>LMWH requires frequent monitoring of anti-Xa levels, and despite therapeutic levels, thrombotic events may occur particularly in women with MHV.</td>
</tr>
<tr>
<td>Frequent monitoring of anticoagulation is essential.</td>
</tr>
<tr>
<td>Some women may require urgent delivery while taking VKAs.</td>
</tr>
<tr>
<td>Risk of maternal thrombosis remains elevated in the postpartum period.</td>
</tr>
</tbody>
</table>

Anticoagulation Management with Prosthetic Valves

<table>
<thead>
<tr>
<th>Pre-pregnancy Planning</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Trimester</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; &amp; 3&lt;sup&gt;rd&lt;/sup&gt; Trimesters</th>
<th>Peripartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC/AHA</td>
<td>Warfarin if dose ≤ 5 mg/d (IIa) or Dose-adjusted LMWH* (IIb) or Dose-adjusted IV UFH† (IIb)</td>
<td>Warfarin + daily Aspirin (I)</td>
<td>Dose-adjusted IV UFH (I)</td>
</tr>
<tr>
<td>ESC</td>
<td>Warfarin if dose &lt; 5 mg/d (IIa) or &gt; 5 mg/d (IIb)</td>
<td>Warfarin (I)</td>
<td>Dose-adjusted LMWH or IV UFH (I)</td>
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</tbody>
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Note: Little evidence of newer oral anticoagulants during pregnancy. Direct thrombin inhibitors, factor Xa inhibitors cross the placenta have not had study during pregnancy.