Critical Care in Obstetrics:

An Innovative and Integrated Model for Learning the Essentials
Pregnancy and Congenital Heart Disease

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I have no conflicts of interest to disclose
Outline

- Learning Objectives
- Background
- Risk assessment
- Pregnancy management
- Congenital heart disease (CHD) in pregnancy
- Summary
Learning Objectives

- Understand pregnancy pathophysiology and effect on CHD
- List maternal and fetal complications with CHD
- Outline pregnancy care for patients with CHD
- Describe lesion-specific care for women with CHD in pregnancy
Background
Background

- 2% of pregnancies involve maternal CV disease
- CHD is the most common form of HD to affect women of childbearing age in North America
- CV disease does not preclude pregnancy but poses ↑ risk to mother and fetus
- Informed CV evaluation ideal pre-pregnancy
Hemodynamic Changes

- Pregnancy is generally well tolerated
  - >40% ↑ in blood volume
  - ↓ in SVR and PVR
  - ↑ in HR 10-20%
  - Little change in BP

- Labor
  - CO ↑ 60-80%
  - HR and BP changes
  - Volume changes
  - ↑ blood volume with uterine contraction
  - ↑ venous return
  - Volume loss during delivery

30% ↑ Cardiac Output (CO)
Pregnancy Not Advised

- Severe pulmonary arterial hypertension
- Severe obstructive lesions
  - AS, MS, PS, HCM, Coarctation
- Ventricular dysfunction
  - CHF - NYHA Class III or IV, EF <40%
  - Prior peripartum cardiomyopathy
- Dilated or unstable aorta
  - Marfan with aorta ≥40-45 mm
- Severe cyanosis
Pregnancy Risk

- **Regurgitant valve lesions**
  - generally well tolerated

- **Complex lesions**
  - assess on case by case basis

- **Risk of inheritance**
  - 3-5% with most CHD
  - Genetic disorders
Risk Assessment
Pre-pregnancy Evaluation

- History, exam, ECG, CXR, med review
- Exercise testing, Echo and additional imaging
- Cardiac catheterization to evaluate possible pulmonary hypertension
- Genetic considerations
Prospective observational data on heart disease in pregnancy

- Few patients with CHD included
- 562 women with 599 pregnancies
- 13% of pregnancies complicated
  - Pulmonary edema, arrhythmia, stroke, cardiac death

Siu SC et al: Circulation 2001
Risk factors

- Prior CHF, TIA, stroke or arrhythmia
- Baseline NYHA class >II or cyanosis
- Left heart obstruction
  - MVA < 2, AVA < 1.5
  - LVOT grad >30 mmHg
- EF <40%

Predictors of Cardiac Events

Siu SC et al: Circulation 2001
Pregnancy Outcome

- ZAHARA study
  - Observational data on CHD in pregnancy
    - 1802 women, 1302 completed pregnancies
  - Cardiac complications in 7.6%
  - Most common CV complications
    - Arrhythmias 4.7%
    - Heart failure 1.6%

Drenthen et al: Eur Heart J 2010
Predictors of Maternal CV Complications

- Cyanotic heart disease ($p < 0.0001$)
- Cardiac meds pre-pregnancy ($p < 0.0001$)
- Left heart obstruction ($p < 0.0001$)
- Mechanical valve prosthesis ($p = 0.0014$)
- Systemic or pulmonary AV valve regurgitation related to complex CHD ($p = 0.03$)

Drenthen et al: Eur Heart J 2010
Modified Risk Score of CV Complications During Pregnancy

1. History of arrhythmias 1.50 points
2. Cardiac medication before pregnancy 1.50 points
3. NYHA class prior to pregnancy ≥1 0.75 points
4. LHD (PG >50 mm Hg or AVA <1.0 cm²) 2.50 points
5. Syst AV valve regurgitation (moderate/severe) 0.75 points
6. Pulm AV valve regurgitation (moderate/severe) 0.75 points
7. Mechanical valve prosthesis 4.25 points
8. Cyanotic heart disease (corrected/uncorrected) 1.00 points

Total number of points 0-13 points

Cardiac complications in % of total number pregnancies

- 0-0.50: 2.9%
- 0.51-1.50: 7.5%
- 1.51-2.50: 17.5%
- 2.51-3.50: 43.1%
- >3.51: 70.0%

Pregnancies at risk (no.):
- 0-0.50: 828
- 0.51-1.50: 280
- 1.51-2.50: 126
- 2.51-3.50: 58
- >3.51: 10

Percentage of total population:
- 0-0.50: 63.6%
- 0.51-1.50: 28.1%
- 1.51-2.50: 6.1%
- 2.51-3.50: 1.4%
- >3.51: 0.8%

Drenthen et al: Eur Heart J 2010
Offspring Complications

- Neonatal complications
  - Premature birth (12%)
  - Small for gestational age (14%)
  - Mortality (4%)

- Predictors of adverse neonatal outcome
  - Cyanotic heart disease ($P = 0.0003$)
  - Mechanical valve replacement ($P = 0.03$)
  - Maternal smoking ($P = 0.007$)
  - Multiple gestation ($P = 0.0014$)
  - Maternal use of cardiac medication ($P = 0.0009$)

Drenthen et al: Eur Heart J 2010
Pregnancy management
Evaluation

- History, exam, ECG, med review
- Echo and additional imaging
- +/- Cardiac catheterization
- Genetics referral/testing
- Frequency of cardiac follow-up depends on type of CHD
Delivery Mode

- Vaginal delivery
  - Feasible and preferable in most cases
  - Facilitate 2nd stage

- Cesarean delivery
  - Obstetrical indications
  - Warfarin anticoagulation in labor
    - Due to fetal bleeding risks
  - Severe pulmonary hypertension
  - Fixed obstructive lesions
    - Sudden BP change dangerous
  - Unstable aorta
CV Surgery During Pregnancy

- 21 CV operations during pregnancy (1976 – 2009)
  - Mortality - 3% maternal, 19% fetal
  - Fetal prematurity and death associated with urgent, high-risk surgery, maternal comorbidity, and early GA
  - Emergent surgery confers higher risk of maternal death
- If intervention required
  - 24-28 weeks best
  - Monitor fetus
  - High flow CPB; MAP >60 mm Hg; maintain normothermia
- CT surgery can be performed with relative safety

Endocarditis Prophylaxis

- Follow AHA guidelines
  - IE prophylaxis generally not required during uncomplicated delivery
- Not required
  - Isolated ASD
  - 6 months after PDA or VSD closure
- Reasonable in high-risk patients
  - Marfan, cyanotic/complex CHD, valve prosthesis
Management of shunt lesions in pregnancy
ASD/AVSD and Pregnancy

- ASD
  - Unrepaired ASD
    - ↑ neonatal risk vs. repaired
    - ↑ pre-eclampsia risk, SGA births
    - ↑ fetal mortality
  - L to R shunt may ↑ with CO change during pregnancy, counterbalanced by ↓ PVR
  - Paradoxical embolism risk
  - Familial types- consider screening

- AVSD
  - After repair - preg usually well tolerated without residua
  - Primum defect - well tolerated when functionally well
  - Down patient - 50% risk of transmitting trisomy 21

Warnes et al: JACC 2008 ACC/AHA Guidelines
Congenital Valve and Stenotic Lesions
Pulmonic Stenosis

- Pregnancy usually well tolerated unless very severe
- Percutaneous valvotomy can be performed during pregnancy
- No maternal CV events >100 preg
- Outcome
  - Preterm delivery in 14.5%
  - Fetal mortality 0.8%
  - Perinatal mortality 4%
  - Recurrent CHD 3%
    - Noonan’s syndrome

Drenthen et al: JACC 2007
Aortic Stenosis
Aortic Stenosis

Unable to augment CO

Preload and hypotension sensitive

CHF and ischemia

\[ \downarrow \text{placental perfusion} \]

\[ \text{IUGR, preterm labor} \]

Suggest delivery at high-risk CV/OB center
Aortic Coarctation
Aortic Coarctation

- Pregnancy generally well tolerated
  - ↑ miscarriages and hypertensive disorders
- Pre-pregnancy assessment – associated lesions/residua
  - coarctation severity, BAV, aorta
- Study 50 pt - 118 pregnancies
  - SAB 9%, prematurity 3%, CHD 4% offspring
  - CV complications infrequent
  - 1 Turner pt - dissection at 36 weeks
- Hypertension
  - 15 pt (30%) during pregnancy
  - 11 (73%) had significant coarctation

Beauchesne et al: JACC 2001
Warnes et al: JACC 2008 ACC/AHA Guidelines
Genetic/Aortic Disorders
Marfan Syndrome

- Unpredictable maternal risk
  - Dissection, rupture, IE, CHF
- Risk based on
  - Preexisting medial changes
  - Changes with pregnancy - Physiologic, hormonal
- Fetal risks - 50% inheritance
  - Autosomal dominant
Case: Marfan

- 20 yo with Marfan
- Pre-pregnancy counseling
  - FH of Marfan, dissection
  - Asymptomatic
- Aortic root = 41 mm
- What do you recommend?

- Counsel against pregnancy!
**Preconception Counseling**

- In addition to routine obstetric screening
  - Detailed CV history, FH, medications and exam
  - Echo — aorta and valves
- Aortic imaging
  - Aorta >45 mm → no pregnancy
  - Aorta ≤40 mm → reasonable if low risk otherwise
  - Aorta 40-45 mm → individualize
- Genetics, prenatal diagnosis
Pregnancy Management

- Management in Marfan and other aortic disorders similar
- During pregnancy
  - Beta-blocker
  - Regular aortic imaging (individualize)
  - Fetal echo
- Peripartum
  - Facilitated vaginal delivery
  - C-section for aorta >40 mm or increasing in size
  - Endocarditis prophylaxis
- Postpartum
  - FU - dissection risk persists
  - Future evaluation of lactation risk
Complex CHD
Complex CHD

- All patients require:
  - specialized CV consultation prior to pregnancy
  - close follow-up during pregnancy

- Uncertainty regarding
  - Conception
  - Pregnancy outcome
  - Effect of CHD on mother and fetus
Cyanotic CHD

- 44 patients - 96 pregnancies
- Adverse fetal outcome associated with ↑ Hb, ↓ O2, type of CHD, functional class
- Fetal outcomes
  - ↑ fetal loss (57%)
  - ↑ Premature birth (37%)
  - ↑ LBW infants
  - ↑ CHD in offspring (5%)
- Maternal outcomes
  - 32% pt CV complications
  - 1 death from endocarditis

Presbitero et al: Circulation 1994
### Adverse fetal outcomes associated with ↓ O₂

<table>
<thead>
<tr>
<th>O₂ sat (%)</th>
<th>≤85</th>
<th>85-89</th>
<th>≥90</th>
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<tbody>
<tr>
<td>Pregnancies (number)</td>
<td>17</td>
<td>22</td>
<td>13</td>
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<tr>
<td>Live Born (number)</td>
<td>2</td>
<td>10</td>
<td>12</td>
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<tr>
<td>Live Born %</td>
<td>12</td>
<td>45</td>
<td>92</td>
</tr>
</tbody>
</table>

Presbitero et al: Circulation 1994
Eisenmenger Syndrome

- Large L → R shunt produces pulmonary hypertension and irreversible PVD
- Shunt reverses R → L causing cyanosis
Eisenmenger Syndrome

- Very limited data on pregnancy
- 12 cases with 13 pregnancies
  - 3 spontaneous abortions
  - 1 premature labor 23 weeks
  - 7 reach 3rd trimester
    - Bed rest, heparin, C-section
- Deaths:
  - 2 maternal deaths 23 – 27 weeks
  - 1 Postpartum at 30 days (PE)

Avila et al: Eur Heart J 1996
Summary
**Summary**

- CVD 1-2% of all pregnancies
- CHD most common in N. Amer.
- Doesn’t preclude pregnancy
- ↑ risk to mother and fetus
- Individual assessment
- Multidisciplinary care
Evidence
Evidence

Guidelines


Level II-2:


Level II-3:

Evidence

Level II-3:


Evidence

Level II-3:

Thank You for Your Attention!

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