ASSESSMENT OF PREGNANCY RISK IN WOMEN WITH CONGENITAL HEART DISEASE

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Congenital Heart Disease

- most common form of heart disease complicating pregnancy in Western countries (~70%)

- presence of maternal CHD associated with significant increase in:
  - heart failure
  - arrhythmias
  - cerebrovascular events
  - embolic events
  - death
Physiological Adaptation of Pregnancy

Antepartum

- ↑ blood volume ~ 40% (peak ~ 32 wks)
- ↑ cardiac output 30-50% (peak ~ 24 wks)
- ↑ heart rate 10-20 bpm (peak ~ 28 wks)
- ↑ pulm blood flow ~ 47%
- ↓ PVR ~ 24% (peak wk 8 onwards)
- ↓ SVR ~ 30% (peak ~ 24 wks rising to near normal towards term)
Preconception

- discussion regarding pregnancy and fetal risks
- consider additional diagnostic evaluation
- consider repair of residual defects pre pregnancy
- consider genetic referral
- discontinue teratogenic drugs
- planned management if anti coagulation required
Prepregnancy Interventions

- ascending aorta conduit
- PVR
- AVR
- Mitral valvuloplasty
- branch PA balloon ± stent
Genetic Risk

~ 18% CHD specific defined genetic abnormality

Autosomal dominant
- Marfan
- Holt-Oram
- Noonan
- Alagille
- CHARGE
- 22q 11.2 microdeletion
- Williams syndromes

Overall risk
- 3-8%
- 10% (if 1 sibling CHD)

Higher risk
- Heterotaxy
- AVSD
- Obstructive lesions LVOT (~ 20%)
Common Maternal Complications during Pregnancy

- Congestive cardiac failure
- Arrhythmias
- Embolic events

Rare
- Maternal death
- Irreversible ventricular dysfunction
Fetal Risk

Higher frequency of

- spontaneous abortions ~ 15-25%
- CHD (fetal echo ~ 20-24 wks)
- Small for gestational age; IUGR
- interventricular haemorrhage
- ↑ risk of pre term births
### Modified WHO classification of maternal cardiovascular risk

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>Risk of Pregnancy by Medical Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No detectable increase of maternal mortality and no/mild increase in morbidity</td>
</tr>
<tr>
<td>II</td>
<td>Small increase risk of maternal mortality or moderate increase in morbidity</td>
</tr>
<tr>
<td>III</td>
<td>Significantly increased risk of maternal mortality or severe morbidity</td>
</tr>
<tr>
<td>IV</td>
<td>Extremely high risk of maternal mortality or severe morbidity. Pregnancy contraindicated. Termination should be discussed.</td>
</tr>
</tbody>
</table>
## Modified WHO Classification of Maternal Cardiovascular Risk (2014)

<table>
<thead>
<tr>
<th>WHO Pregnancy Risk Category</th>
<th>Risk Description</th>
<th>Maternal Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No detectable increase in maternal mortality and no/mild increase in morbidity risk</td>
<td>Mild pulmonary stenosis PDA, MVP Post ASD/VSD/PDA/ anomalous PVD repair</td>
</tr>
<tr>
<td>2</td>
<td>Small increase in maternal mortality and moderate increase in morbidity risk</td>
<td>Unoperated ASD, VSD Repaired TOF Most arrhythmias</td>
</tr>
</tbody>
</table>
| 3                           | Significantly increased maternal mortality or severe morbidity risk. Specialist cardiac and obstetric monitoring required throughout pregnancy, childbirth and the puerperium | • Mechanical valve  
• Systemic RV  
• Fontan circulation  
• Unrepaired cyanotic heart disease  
• Other complex CHD  
• Aortic dilitation 40-45 Marfan syndrome  
• Aortic dilitation 45-50 in bicuspid aortic valve aortopathy |
| 4                           | Extremely high maternal mortality or severe morbidity risk. Pregnancy is C/I. Termination should be considered. | • Pulmonary arterial hypertension  
• Severe systemic ventricular dysfunction LVEF <30%, NYHA Class III-IV  
• Previous peripartum cardiomyopathy with residual LV impairment  
• Severe MS/AS  
• Native severe coarctation  
• Aortic dilation >45mm Marfan  
• Aortic dilation >50mm in BAV |
Consider Termination if

- severe pulmonary hypertension
- severe systemic ventricular dysfunction
- severe aortic dilatation
- mechanical mitral valve prosthesis
## Medications During Pregnancy

<table>
<thead>
<tr>
<th>Medication Category</th>
<th>Medications</th>
<th>FDA pregnancy Category</th>
<th>Teratogenic risks</th>
<th>Other</th>
<th>Lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Blockers</td>
<td>Metoprolol, Propanolol, Carvedilol, Atenolol</td>
<td>B, C</td>
<td>None</td>
<td>Possible association with fetal growth restriction (atenolol, propanolol)</td>
<td>Probably safe, except for atenolol</td>
</tr>
<tr>
<td>Combined α-B blockers</td>
<td>Labetalol</td>
<td>C</td>
<td>None</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ACEI</td>
<td>Captopril, Enalapril, Lisinopril</td>
<td>C (first trimester), D (2nd and 3rd trimester)</td>
<td>Fetal renal dysplasia, Oligohydraminios, Fetal death</td>
<td></td>
<td>Yes (captopril and enalapril), Lisinopril – unknown</td>
</tr>
<tr>
<td>Vasodilators</td>
<td>Sildenafil</td>
<td>B</td>
<td>None</td>
<td>No</td>
<td>Unknown</td>
</tr>
<tr>
<td>Diuretics</td>
<td>Furosemide, Spironolactone (not recommended)</td>
<td>C</td>
<td>None</td>
<td>Possible association with neonatal PDA and sensorinical hearing loss</td>
<td>No</td>
</tr>
<tr>
<td>Antiarrhythmics</td>
<td>Sotalol, Amiodarone, Adenosine, Adenosine</td>
<td>B, D, C</td>
<td>None</td>
<td>Thyroid dysfunction and IUGR</td>
<td>No</td>
</tr>
<tr>
<td>Endothelium receptor antagonists</td>
<td>Bosentan, Macitentan</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Maternal Risk with Congenital Heart Disease and Pregnancy

Low Risk
- left to right shunts (ASD – risk of paradoxical embolus low)
- repaired AVSD
- Ebstein’s anomaly (if no cyanosis)
- pulmonary/mitral/aortic/tricuspid regurgitation

Medium Risk
- moderate to severe aortic stenosis
- mild to moderate systemic ventricular dysfunction
- repaired coarctation of the aorta
- post TOF repair with severe PR
- post arterial switch repair for DTGA
Maternal Risk with Congenital Heart Disease and Pregnancy

High Risk
- post Fontan repair
- cyanotic
- post Mustard/Senning repair for DTGA
- Marfan’s with Ao root > 40mm

Extreme risk
- Eisenmenger syndrome
- severe pulmonary hypertension
- symptomatic aortic stenosis
- Marfan’s with Ao root > 45mm
- symptomatic severe systemic ventricular dysfunction
Aortic Stenosis and Pregnancy

Low risk
- mild aortic stenosis
- NYHA class I
- exercise test satisfactory
- normal LV function

Medium
- asymptomatic moderate-severe aortic stenosis

Very high
- symptomatic aortic stenosis
- AS with LV dysfunction
- bicuspid aortic valve with ascending aorta $>$45mm
- consider aortic balloon valvuloplasty
Moderate to Severe Asymptomatic Aortic Stenosis and Pregnant

Risks of
• congestive cardiac failure ~10%
• arrhythmias ~ 10%
• mortality rare

Fetal risks (25%)
• prematurity
• IUGR
• low birth weight

Pregnancy & delivery
• vaginal delivery usually preferred, early epidural ± planned induction
• Caesarean section may be necessary if early delivery required (ie 34-36 weeks)
Pregnancy post atrial switch repair (Mustard/Senning)

Very high risk if

- NYHA >II; poor exercise tolerance
- RV dysfunction EF <40%
- >mild TR
Pregnancy and Marfan Syndrome

Contra-indicated if
- aortic root $\geq 45\text{mm}$ (ECS + Canadian guidelines)
- previous aortic dissection

Pre-pregnancy
- recent CTA/MRA
- if identified mutation, preimplantation genetic diagnosis possible
- stop ACEI/ARB
- continue BB

Pregnancy
- echo every 4-6 weeks
Gene(s) most commonly identified for the clinical aortopathy diagnosis (CSANZ 2016)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Gene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marfan Syndrome (AD)</td>
<td>FBN1</td>
</tr>
<tr>
<td>Loeys-Dietz Syndrome (AD)</td>
<td>TGFBR2, TGFBR1, SMAD3, TGFBR2</td>
</tr>
<tr>
<td>Enhlers Danlos Syndrome (Type IV)</td>
<td>COL3A1</td>
</tr>
<tr>
<td>Arterial Tortuosity Syndrome (AR)</td>
<td>SLC2A10</td>
</tr>
<tr>
<td>Non-systemic TAAD</td>
<td>ACTA2, MYH11, PRKGI, MYLK</td>
</tr>
<tr>
<td>Bicuspid Aortic Valve</td>
<td>NOTCH1</td>
</tr>
</tbody>
</table>
Turner Syndrome

Aortic surgery pre pregnancy if

- Aortic root $> 2.5\text{cm/m}^2$ (otherwise $> 2.7\text{cm/m}^2$)

High risk

- Aortic root $2.0\text{cm/m}^2 – 2.4\text{cm/m}^2$
Fontan and Pregnancy

Very high risk (maternal and fetal) if -

- past atrial arrhythmias
- past pulmonary emboli
- ↓ exercise tolerance
- NYHA > II
- cyanosis with arterial $O_2$ sat$^n$ <85% at rest or on exercise
- systemic ventricular dysfunction ↓ EF
High Risk

- arterial O2 sat\textsuperscript{n} > 85% (rest and exercise)
- normal systemic ventricular EF
- good exercise tolerance (>9min Bruce protocol)
- \leq mild atrioventricular regurgitation
- NYHA Grade 1-2
- sinus rhythm
Pregnancy and Cyanotic Congenital Heart Disease (excluding Eisenmenger’s, severe PHT)

- mixed group (Ebstein’s + PFO; CCTGA/VSD/PS; univentricular hearts; unrepaired TOF; PA + VSD)

Risks
- congestive cardiac failure (? Permanent deterioration)
- arrhythmias mainly atrial
- cardioembolic events (esp post partum)

Prepregnancy
- repair if possible
- exercise test helpful
- fetal risks very high if arterial O2 saturation <85%
Eisenmenger Syndrome

- termination advised
- maternal mortality improved but still ~25%
- cease ERA – (teratogenic in animals)
- consider sildenafil/tadalafil ± prostacyclin derivatives
- consider diuretics, anticoagulants, restrict exercise
- early planned delivery around 32-34 weeks
- stay in hospital at least 1 week post delivery
Mode of Delivery

- generally vaginal delivery preferred
- consider induction/early epidural
- haemodynamic monitoring during labour and delivery

Caesarean section usually preferred/necessary if
- delivery before 36 weeks
- Marfan syndrome/dilated aorta
CONCLUSION

- **Management of pregnancy includes**
  - preconception care
  - pregnancy management
  - planning of labour and mode of delivery
  - postpartum care

- **Very high risk**
  - systemic ventricular dysfunction
  - cyanosis (arterial O$_2$ sat$^n$ <85%)
  - NYHA >II, poor exercise tolerance
  - pulmonary hypertension
CONCLUSION

Pregnancy in Women with Congenital Heart Disease

• multidisciplinary team required
• medical management/interventions frequently required
• significant risks to both mother and baby

However,
• outcomes generally good except in the very high risk groups
Predictors of maternal CVS events and risk score from CARPREG study

- Prior cardiac event (CCF, TIA, CVA, arrhythmias)
- NYHA class >II or cyanosis
- mitral stenosis, aortic stenosis
- systemic ventricular EF <40%

<table>
<thead>
<tr>
<th>Point</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5%</td>
</tr>
<tr>
<td>1</td>
<td>27%</td>
</tr>
<tr>
<td>&gt;1</td>
<td>75%</td>
</tr>
</tbody>
</table>
ZAHARA predictors

- past arrhythmia event
- NYHA class >II
- severe aortic stenosis (PG >50mmHg)
- mechanical valve prosthesis
- moderate/severe atrioventricular valve regurgitation
- use of cardiac medication pre-pregnancy
- cyanosis