Congenital and Valvular Heart Disease in Pregnancy

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Internal Medicine-Cardiology
Adult Congenital Heart Diseases
Objectives

• To present how pregnancy alters the pathophysiology of congenital and valvular heart disease

• To discuss adjustments in management/special precautions to ensure safety of both mother and fetus
“If you have heart disease
Don’t fall in love

If you fall in love
Don’t make love

If you make love
Don’t get pregnant”

Dr. Carole Warnes, ACHD Program Director, Mayo Clinic
Anatomic Alterations

- Heart size can increase by up to 30%\(^1\)
  - Heart appears larger on chest X-ray
- Cardiac apex is deviated and slightly rotated to the left \(^2\)
  - Left axis deviation of approximately 15 degrees

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
(2) Bonica, J. Principles and Practice of Obstetric Analgesia and Anesthesia. 1967
Hemodynamic Changes in Pregnancy

The Heart During Pregnancy

1. Beats faster
2. Pumps more blood
3. Generally works much harder

This can be hard for a diseased heart!

Modified from: Silversides, C. “Women with Congenital Heart Disease-Understanding the Challenges of Pregnancy.” ACHA Webinars 2012
Heart Disease in Pregnancy

• Most women with heart disease can go through pregnancy and delivery safely
• Identifying those at high risk for maternal morbidity and mortality and adverse fetal outcome is essential
  — These patients need multi-disciplinary specialist care at experienced centers
## Models of Risk Estimation

<table>
<thead>
<tr>
<th>Predictors</th>
<th>ZAHARA</th>
<th>CARPREG</th>
<th>Khairy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical valve prosthesis</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left heart obstruction</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>History of arrhythmias</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Cardiac medication during pregnancy</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanotic heart disease</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemic ventricular dysfunction</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Pulmonary atrioventricular valve reg.</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Systemic atrioventricular valve reg.</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYHA class &gt; 2 prior to pregnancy</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
(2) Thorne, S. Risks of Contraception and Pregnancy in Heart Disease. Heart. 2006
## Modified WHO Classification of Maternal Risk

<table>
<thead>
<tr>
<th>WHO</th>
<th>Risk</th>
<th>Mortality</th>
<th>Morbidity</th>
<th>Specialist care needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Low risk</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Moderate risk</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>High risk</td>
<td>↑↑</td>
<td>↑↑</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Pregnancy Contraindicated</td>
<td>↑↑↑↑</td>
<td>↑↑↑↑</td>
<td></td>
</tr>
</tbody>
</table>

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011  
(2) Thorne, S. Risks of Contraception and Pregnancy in Heart Disease. Heart. 2006
WHO III – High Risk Pregnancy

- Mechanical valve
- Systemic right ventricle
- Fontan circulation
- Cyanotic heart disease (unrepaired)
- Other Complex CHD
- Marfan syndrome w/ aorta 40-45 mm
- BAV w/ aorta 45-50 mm

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
WHO IV – Pregnancy Contraindicated

- PAH of any cause
- Severe systemic ventricular dysfunction (EF < 30% or NYHA III-IV)
- Previous peripartal cardiomyopathy with any residual impairment of LVEF
- Severe MS
- Severe symptomatic AS
- Native severe aortic coarctation
- Marfan Syndrome w/ aorta > 45 mm
- BAV w/ aorta > 50 mm

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Left-Sided Obstruction

Mechanical Valves

High Risk!

Cyanosis

Big Aorta (Marfan or BAV)

Pulmonary Arterial Hypertension

Low EF
Valvular Heart Disease: Effects of pregnancy and management issues
Valvular Heart Disease

• Nature of valve lesion
  – stenosis or regurgitation?

• Native valve or prosthetic valve?
  – Bioprosthetic valve or mechanical valve?

• Presence of ventricular dysfunction or associated lesions?
Valvular Heart Disease

**STENOSIS**

- Increase in cardiac output
  - Increase in transvalvular gradients

**REGURGITATION**

- Decrease in systemic vascular resistance
  - Decrease in regurgitant volumes

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Moderate to severe MS

- Poorly tolerated in pregnancy
- HF occurs often (2\textsuperscript{nd} or 3\textsuperscript{rd} trimesters, during, or immediately after delivery)
  - If mitral valve area < 1.5 cm\textsuperscript{2}
  - HF is often progressive even if previously asymptomatic

Maternal mortality: 0-3%
Prematurity: 20-30%
IUGR: 5-20%

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Mitral stenosis

- **B1-selective beta-blockers**
  - If w/ symptoms or pulmonary HPN (> 50 mmHg)
  - e.g. Metoprolol, nebivolol, bisoprolol
  - Atenolol is contraindicated

- **Diuretics**
  - If w/ congestive symptoms despite beta blocker use
  - e.g. Furosemide, thiazides
  - Spironolactone is contraindicated

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Mitral Stenosis

• Therapeutic anticoagulation is recommended in:
  – Paroxysmal AF
  – LA thrombosis
  – Prior embolism
  – Moderate or severe MS and
    • Spontaneous echo contrast in LA
    • Large LA (> 40 mL/m2)
    • Low cardiac output
    • Congestive heart failure

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Mitral Stenosis

• Percutaneous Transvenous Mitral Comissurotomy (PTMC)
  – Should be performed pre-pregnancy
  – If performed during pregnancy, must be done after 20 wks of gestation
  • Severe symptoms (NYHA III/IV) despite medical therapy
  • Systolic PAP > 50 mmHg
  – Precautionary measures: abdominal shielding and lowest radiation dose

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Mitral Stenosis

• Delivery
  – **Vaginal** in moderate to severe MS, in NYHA class I/II without pulmonary hypertension
  – **Caesarian section** in moderate to severe MS in NYHA class III/IV, pulmonary hypertension, or when PTMC cannot be performed or has failed

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Aortic Stenosis

• Congenital (bicuspid aortic valve) or rheumatic
• Patients can be asymptomatic even in severe AS
  – Evaluate symptoms by exercise test pre-pregnancy
• HF in 10% and arrhythmias in 3-25% of severe AS
• Those with AS associated with bicuspid aortic valve have a risk of aortic dilatation and dissection.

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
## Aortic Stenosis

<table>
<thead>
<tr>
<th>Severity of AS</th>
<th>Pregnancy risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic mild or moderate AS</td>
<td>Tolerated</td>
</tr>
<tr>
<td>Asymptomatic severe AS w/ normal BP response on exercise</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic severe AS w/ pathologic exercise test or w/ LV dysfunction</td>
<td>Poorly-tolerated</td>
</tr>
<tr>
<td>Symptomatic severe AS</td>
<td></td>
</tr>
</tbody>
</table>

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Aortic Stenosis

• Patients with severe AS should undergo intervention pre-pregnancy if:
  – They are symptomatic
  – LV dysfunction (LVEF < 50%)  Class I-B

• Asymptomatic patients with severe AS should undergo intervention pre-pregnancy when they:
  – develop symptoms  Class I-C
  – there is a fall in BP below baseline during exercise testing  Class IIa-C
Mitral and Aortic Regurgitation

• Etiology: congenital, rheumatic, degenerative
• Lower pregnancy risk than stenotic lesions
  – Decreased systemic vascular resistance
  – Reduced regurgitant volume
• Maternal risk is dependent on regurgitation severity and LV function
Mitral and Aortic Regurgitation

• Patients w/ severe MR or AR + symptoms should undergo surgical treatment pre-pregnancy.  
  Class I-C

• Medical management as in non-pregnant patients, except:
  Class I-C
  – ACE-I, ARB, Aldosterone antagonist, DRI contraindicated
Mechanical Valve

• Mechanical valve = anticoagulation
• During pregnancy, concerns are:
  – Increased risk of valve thrombosis
  – Hemorrhage
  – Fetal complications
Mechanical Valve

1st Trimester: Oral Anticoagulation (Warfarin < 5 mg)
2nd Trimester: Weekly PTT/anti-Xa monitoring
3rd Trimester: PT-INR monitoring (Target 2.5)
36th wk AOG: Planned Delivery

UFH/LMWH throughout the pregnancy
Congenital Heart Disease: Effects of pregnancy and management issues
Congenital Heart Disease

- Many women with CHD tolerate pregnancy
- Risk of pregnancy depends on the severity of the underlying structural heart disease
  - Ventricular function
  - Valvular function
  - Functional class
  - Cyanosis
Maternal Mortality in CHD
Congenital Heart Disease

![Graph showing abortion, miscarriage, and completed pregnancies rates for various congenital heart defects.](Image)
Cyanotic CHD (without PHPN)

- O2 saturation < 85%
- Examples: TOF, Pulmonary atresia + VSD
- Degree of maternal hypoxemia is the most important predictor of outcome
- Maternal complications 30%
- Management
  - Bed rest
  - Supplemental oxygen
  - Anticoagulation
Fetal Outcomes of Pregnancy in Cyanotic CHD

Maternal Hgb vs.
% Livebirths

Maternal O2 Sat vs.
% Livebirths

Eisenmenger Syndrome

• Large shunt produces pulmonary hypertension and irreversible pulmonary vascular disease
• Shunt reversal causing cyanosis
• Maternal mortality 20-50%
• Live birth < 12% if O₂ sat < 85%
PREGNANCY

↓ SVR  ↑ CO  ↑ Coagulability  ↑ O2 Consumption  ↑ Blood Volume

R → L Shunt  Pulmonary Embolism  RV dilatation and failure

Hypoxemia  Hypotension  RV Ischemia

LV underfilling, ↓ CO

Shock  Delivery  Blood loss, vasovagal reflex  ↑ Venous return

LV underfilling, Hypotension  Hypoxemia  Shock

Eisenmenger Syndrome

- Supplemental iron
- Anticoagulation for some patients
- Judicious diuretic use if indicated
Pulmonary Hypertension

• Mean PAP of > 25 mmHg at rest or > 30 mmHg during exercise

• Maternal mortality: 17-33%
  – Most often in the last trimester and first months after pregnancy

Causes:
1. Refractory right heart failure
2. Pulmonary thrombosis
3. Pulmonary hypertensive crises

• Neonatal mortality rate: 11-13%

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Pulmonary Hypertension

• Supplemental oxygen
  – Given if w/ hypoxemia

• Sildenafil
  – Others: IV prostacyclin, nebulized iloprost or NO

• Anticoagulation
  – Indications: PA thrombosis or right heart failure

• AVOID:
  – Systemic hypotension
  – Acidosis
  – Hypoxia
  – hypovolemia
Mode of Delivery

Vaginal Delivery
• Smaller shifts in blood volume
• Fewer clotting and bleeding
• Lower risk of infection

Caesarian section
• More controlled setting
• Avoids a prolonged 2nd stage of labor
• Preferred in:
  – Patients on oral anticoagulants and on pre-term labor
  – Marfan Syndrome w/ aortic diameter of > 45 mm
  – Acute intractable heart failure
Infective Endocarditis Prophylaxis

• “given the lack of convincing evidence that infective endocarditis is related to either vaginal or Caesarian delivery, antibiotic prophylaxis is not recommended during delivery

– European Society of Cardiology “Guidelines in the Management of Cardiovascular Diseases in Pregnancy 2011”
Infective Endocarditis

• “preventive antimicrobial treatment is not denied considering the risk-benefit balance”

Infective Endocarditis Prophylaxis

- In the Philippines, no reported infective endocarditis was directly related to pregnancy and delivery (n=332) in retrospective studies
- Prospective data needed

Post Partum Care

- Hemodynamic changes and fluid shifts occur in the first 12-24 hours after delivery
- Early ambulation to reduce risk of thromboembolic events
- Monitor for occurrence of post-partum hemorrhage
Contraception
## Contraception

<table>
<thead>
<tr>
<th>Birth Control Method</th>
<th>Failure rates Typical Use(%)</th>
<th>Failure rates Perfect Use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No method</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Calendar-Rhythm Method</td>
<td>38</td>
<td>20-24%</td>
</tr>
<tr>
<td>Barriers</td>
<td>15-32</td>
<td>2-26</td>
</tr>
<tr>
<td>Progesterone only pills</td>
<td>5-10</td>
<td>0.5</td>
</tr>
<tr>
<td>Combines OCP</td>
<td>3-8</td>
<td>0.1</td>
</tr>
<tr>
<td>Depo provera</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>Copper IUD</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Female sterilization</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Male sterilization</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Combined Estrogen-Progesterone OCPs

DO NOT USE
• Cyanotic heart disease
• Ejection fraction < 30%
• Pulmonary hypertension of any cause
• Ischemic heart disease
• Fontan circulation
• Pulmonary AVM
• Previous arteritis
• Mechanical valve (Starr Edwards, Bjork Shiley)

CAUTION IN USE
• Previous thromboembolism
• Atrial arrhythmias
• Dilated LA (> 4 cm)
• Reversal of L→R shunts (unoperated ASD)

Most convenient and reliable method! Ethinyl estradiol dose must be at 30 ug
Adverse events: systemic HPN, venous thrombosis

## Contraception

<table>
<thead>
<tr>
<th>Contraceptive Method</th>
<th>Adverse events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progesterone only pill</td>
<td>Fluid retention, poor compliance: must be taken same time daily</td>
</tr>
<tr>
<td></td>
<td>Less thrombogenic potential</td>
</tr>
<tr>
<td></td>
<td>Less effective (does not suppress ovulation)</td>
</tr>
<tr>
<td>Depo-progesterone injection</td>
<td>Fluid retention</td>
</tr>
<tr>
<td></td>
<td>Irregular bleeding</td>
</tr>
<tr>
<td>Intra-Uterine Device (IUD)</td>
<td>Vagal response during insertion (5%)</td>
</tr>
<tr>
<td></td>
<td>Menorrhagia, PID</td>
</tr>
<tr>
<td>Bilateral Tubal Ligation</td>
<td><strong>Laparotomy:</strong> hypotension w/ GA induction</td>
</tr>
<tr>
<td></td>
<td><strong>Laparoscopy:</strong> Abdominal distention w/ CO2 can decrease venous return</td>
</tr>
<tr>
<td>Vasectomy</td>
<td>Male partner may outlive female</td>
</tr>
</tbody>
</table>

(1) Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
(2) Gatzoulis et al. Diagnosis and Management of ACHD. 2012
<table>
<thead>
<tr>
<th>Type of CHD</th>
<th>Recurrence risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicuspid aortic valve</td>
<td>8.0</td>
</tr>
<tr>
<td>AV septal defect</td>
<td>3.0-4.0</td>
</tr>
<tr>
<td>Hypoplastic left heart</td>
<td>3.8</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>2.5-3.0</td>
</tr>
<tr>
<td>Left sided heart obstructions</td>
<td>3.0</td>
</tr>
<tr>
<td>Atrial septal defect</td>
<td>3.0</td>
</tr>
<tr>
<td>Transposition of the great arteries</td>
<td>1.0-1.8</td>
</tr>
</tbody>
</table>
ESC Guidelines on the management of cardiovascular diseases during pregnancy

The Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC)
Issues in Pregnant Women with Heart Disease

Increased demands on the heart

Pre-Pregnancy
- Counseling
- Optimizing status before pregnancy

Pregnancy
- Minimizing risk for the mother
- Minimizing risk for the fetus
- Safety of treatment

Delivery

Post-partum
- Long term effects to the mother
- Long term effects on the baby

Modified from: Silversides, C. “Women with Congenital Heart Disease-Understanding the Challenges of Pregnancy.” ACHA Webinars 2012
Summary

• Physiologic changes during pregnancy may impact negatively on diseased hearts
• Most women w/ heart disease can go through pregnancy safely
• Identify patients at highest risk
• Individualize management
• Multi-disciplinary team approach at experienced centers is desired for high risk patients
PRESENTATION
FINISHED!
Pre-pregnancy Counseling

- Risk stratification
- Advise on contraception
- Genetic counseling
Percentage of 16 year olds having sexual intercourse

Timely counseling is essential !!!

<table>
<thead>
<tr>
<th>MD Judgment vs. Patient Perception on Risk of Pregnancy</th>
<th>MD Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OK for Pregnancy</td>
</tr>
<tr>
<td>Patient Perception (n=116)</td>
<td>83</td>
</tr>
<tr>
<td>OK for Pregnancy</td>
<td>17</td>
</tr>
<tr>
<td>Avoid Pregnancy</td>
<td></td>
</tr>
</tbody>
</table>

21% were not aware of correct pregnancy risk

Kovacs, A. et al. JACC 2008
## Radiation Exposure in Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Fetal Exposure (mGy)</th>
<th>Maternal Exposure (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest X ray</td>
<td>&lt;0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>Chest CT</td>
<td>0.3</td>
<td>7</td>
</tr>
<tr>
<td>Coro Angio</td>
<td>1.5</td>
<td>7</td>
</tr>
<tr>
<td>PCI or catheter ablation</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

Ionizing radiation should be < 50 mGy

Procedures postponed after the 1st trimester if possible

Modified from Regitz-Zagrosek, et al. ESC CV Disease in Pregnancy Guidelines. 2011
Drug Therapy in Pregnancy

- There are no uniform recommendations
- In case of emergency, drugs that are not recommended during pregnancy and breastfeeding should not be withheld to the mother.
- The potential risk and benefit must be weighed against each other.
Category B

- Animal studies: no fetal risk but no controlled study on pregnant women
- Animal studies: adverse event not confirmed in controlled studies in pregnant women
- Aspirin
- LMWH and UFH
- Nitrates
- Methyldopa
- Hydrochlorothiazide
- Sotalol
- Beta-lactams and cephalosporins
Category C

• Animal studies: adverse effects on fetus BUT no controlled studies in women
• NO available studies in both women and animals

Must only be given if benefit > risk

• Digoxin
• Clopidogrel
• Beta blockers
• Furosemide
• Calcium-channel blockers
• Hydralazine
• Fibrates
• Class I anti-arrhythmics
• Imipenem, vancomycin, teicoplanin, rifampicin
Class D

- Evidence of human fetal risk
- Benefits from use may be acceptable despite risk

Treatment of life-threatening conditions

- Warfarin
- Amiodarone
- ACE inhibitors
- Angiotensin receptor blockers
- Spironolactone
- Aminoglycosides, quinolones, tetracycline
Class X

- Studies in animals or humans demonstrated fetal abnormalities
- Risk clearly outweighs benefit

Contraindicated !!!

- Statins
- Bosentan
## Infective Endocarditis Prophylaxis

### ACC/AHA VHD Focused Update 2008

<table>
<thead>
<tr>
<th>Congenital Heart Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrepaired cyanotic CHD (inc. palliative shunts, conduits)</td>
</tr>
<tr>
<td>Completely repaired CHD w/ prosthetic material w/in 6 mos after the procedure</td>
</tr>
<tr>
<td>Repaired CHD with residual defects w/ in site of a prosthetic patch/device</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prosthetic valve</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Previous IE</th>
</tr>
</thead>
</table>

| Cardiac transplant patients w/ regurgitation from structurally abnormal valve |
# Mechanical Valve

<table>
<thead>
<tr>
<th>Trimester</th>
<th>Oral Anticoagulation ¹</th>
<th>UFH</th>
<th>Oral Anticoagulation ¹</th>
<th>UFH ¹</th>
<th>LMWH ²</th>
<th>UFH ¹</th>
<th>Maternal Mortality</th>
<th>Valve thrombosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>2nd</td>
<td>Oral Anticoagulation ¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4%</td>
<td>9%</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Oral Anticoagulation ¹</td>
<td></td>
<td></td>
<td></td>
<td>? %</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>15%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Mechanical Valve

• Warfarin embryopathy: mainly nasal hypoplasia, sometimes severe abnormalities
  – 0% if avoided in weeks 6-12

• Incidence of embryopathy in using Warfarin throughout pregnancy:
  – 6.4 % (n=549 pregnancies) \(^1\)
  – 6.0% (n= 394 pregnancies) \(^2\)

\(^2\) Van Driel, et al. Fetal effects after in-utero exposure to coumarin. Teratology. 2002
Mechanical Valve

• Warfarin embryopathy is dose dependent
• Dose effect (< 5 mg Warfarin/day)
  – 0% - 2.6%
• No difference between heparin and warfarin in miscarriage rates

## Mechanical Valve

<table>
<thead>
<tr>
<th></th>
<th>Warfarin &lt; 5 mg (n=33)</th>
<th>Warfarin &gt; 5 mg (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin dose</td>
<td>4.0 ± 0.8</td>
<td>7.5 ± 0.9</td>
</tr>
<tr>
<td>INR</td>
<td>2.9 ± 0.4</td>
<td>3.0 ± 0.4</td>
</tr>
<tr>
<td>Healthy babies</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>Spontaneous abortion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; trimester</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; trimester</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IUGR</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Embryopathy</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Prosthetic thrombosis</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

## Mechanical Valve and LMWH

<table>
<thead>
<tr>
<th></th>
<th>Oran</th>
<th>Quinn</th>
<th>Abligaard</th>
<th>Yinon</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=pregnancies</td>
<td>81</td>
<td>12</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>n= women</td>
<td>75</td>
<td>11</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>-</td>
<td>30</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td><strong>Prosthesis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitral</td>
<td>44</td>
<td>4</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Aortic</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>LMWH 2\textsuperscript{nd} and 3\textsuperscript{rd} trim</td>
<td>74</td>
<td>92</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Anti-Xa Monitoring</td>
<td>63</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Aspirin</td>
<td>NA</td>
<td>33</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Thromboembolic events</td>
<td>10 (12%)</td>
<td>1 (8%)</td>
<td>2 (17%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Prosthetic thrombosis</td>
<td>7 (9%)</td>
<td>1 (8%)</td>
<td>1 (8%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Maternal death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (4%)</td>
</tr>
</tbody>
</table>
Atrial Septal Defects

- Usually tolerate pregnancy well
- Increased risk for atrial arrhythmias and paradoxical embolus
- Early post partum ambulation
- Elective closure before pregnancy
Ventricular Septal Defects

- Usually tolerate pregnancy well as long as without LV dysfunction and pulmonary hypertension