CARDIOPULMONARY BYPASS IN THE PREGNANT CARDIAC PATIENT—MATERNAL FETAL CONFLICT

Dr. Anis S. Baraka, MD, FRCA (Hon)
Professor of Anesthesiology American University of Beirut
Beirut –Lebanon

The report will discuss the hemodynamic changes of pregnancy and its interaction with the acquired and congenital heart disease during pregnancy. The report will also outline the suggested precautions during cardiopulmonary bypass which may affect the mother and/or the fetus such as pump flow, mean arterial pressure, hypothermia and hemodilutional CPB.

1. HEMODYNAMIC CHANGES DURING PREGNANCY

   Changes in Cardiovascular System

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood volume</td>
<td>+35%</td>
</tr>
<tr>
<td>Plasma volume</td>
<td>+45%</td>
</tr>
<tr>
<td>Red blood cell volume</td>
<td>+20%</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>+40%</td>
</tr>
<tr>
<td>Stroke volume</td>
<td>+30%</td>
</tr>
<tr>
<td>Heart rate</td>
<td>+15%</td>
</tr>
<tr>
<td>Femoral (uterine?) venous pressure</td>
<td>+15 torr</td>
</tr>
<tr>
<td>Total peripheral resistance</td>
<td>-15%</td>
</tr>
<tr>
<td>Mean arterial blood pressure</td>
<td>-15 torr</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>-0.5 torr</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>-10-20 torr</td>
</tr>
<tr>
<td>Central venous pressure</td>
<td>no change</td>
</tr>
</tbody>
</table>

2. INTERACTION OF HEMODYNAMIC CHANGES OF PREGNANCY WITH CARDIAC DISEASE

<table>
<thead>
<tr>
<th>MALADAPT</th>
<th>ADAPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral Stenosis</td>
<td>Mitral Regurgitation</td>
</tr>
<tr>
<td>Aortic Stenosis</td>
<td>Aortic Regurgitation</td>
</tr>
<tr>
<td>R-L Shunt</td>
<td>L-R Shunt</td>
</tr>
</tbody>
</table>
3. COMMON CARDIOVASCULAR DISEASES AND RECOMMENDATIONS

- **Mitral Stenosis: Anesthetic Considerations**
  1. Prevent rapid ventricular rates
  2. Minimize increases in central blood volume
  3. Avoid marked decreases in systemic vascular resistance
  4. Prevent increases in pulmonary artery pressure

- **Mitral Insufficiency: Anesthetic Considerations**
  1. Prevent peripheral vasoconstriction
  2. Avoid myocardial depressants
  3. Treat acute atrial fibrillation immediately
  4. Maintain a normal or slightly elevated heart rate
  5. Monitor PCW pressure and intensity of murmur

- **Acute Insufficiency: Anesthetic Considerations**
  1. Avoid marked increases in systemic vascular resistance
  2. Maintain a normal or slightly elevated heart rate
  3. Avoid myocardial depressants
  4. Monitor arterial diastolic pressure, PCW pressure, and intensity of murmur

- **Aortic Stenosis: Anesthetic Considerations**
  1. Avoid decreases in systemic vascular resistance
  2. Avoid bradycardia
  3. Maintain venous return and left ventricular filling.

- **Anesthetic Considerations: Ventricular Septal Defect**
  1. Avoid marked increases in systemic vascular resistance
  2. Avoid marked increases in heart rate
  3. With pulmonary hypertension, avoid marked decreases in systemic vascular resistance
  4. With pulmonary hypertension, avoid marked increases in pulmonary vascular resistance

- **Anesthetic Considerations: Tetralogy of Fallot**
  1. Avoid decreases in systemic vascular resistance
  2. Avoid decreases in blood volume
  3. Avoid decreases in venous return
  4. Avoid myocardial depressants

- **Anesthetic Considerations: Eisenmenger's Syndrome**
  1. Avoid decreases in systemic vascular resistance
2. Avoid decreases in venous return
3. Avoid increases in pulmonary vascular resistance (e.g. hypercarbia, acidosis, hypoxia)

- **Anesthetic Considerations: Primary Pulmonary Hypertension**
  1. Avoid increases in pulmonary vascular resistance
  2. Avoid marked decreases in venous return
  3. Avoid marked decreases in systemic vascular resistance
  4. Avoid myocardial depressants

4. **RECOMMENDATIONS OF CARDIOPULMONARY BYPASS DURING PREGNANCY**

1. The maintenance of perfusion pressure & blood flow during CPB at greater than usual values to match the increase in cardiac output associated with pregnancy
2. The avoidance of severe hemodilution
3. The maintenance of normothermic perfusion. However, when hypothermia is indicated during CPB, the use of a moderate or even tepid hypothermic technique associated with an alpha-stat strategy for acid base management is recommended

   Continuous cardiotocographic monitoring for fetal heart rate should be maintained throughout the procedure, and a prophylactic tocolytic regimen may be used