Anesthesia for the Child with Congenital Heart Disease (CHD) for Non-cardiac Surgery

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OBJECTIVES

- Demographics
- Determinants of physiologic function
- Surgical procedures
- Anesthetic management

PREVALENCE OF CONGENITAL HEART MALFORMATIONS

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Infants</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular septal defect</td>
<td>28.3</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Patent ductus arteriosus</td>
<td>12.5</td>
<td>15</td>
<td>15.5</td>
</tr>
<tr>
<td>Atrial septal defect</td>
<td>9.7</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Coarctation</td>
<td>8.8</td>
<td>4.5</td>
<td>8</td>
</tr>
<tr>
<td>Transposition of great art</td>
<td>8</td>
<td>4.5</td>
<td>2</td>
</tr>
<tr>
<td>Hypoplastic left heart synd</td>
<td>7.8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>7</td>
<td>11</td>
<td>15.5</td>
</tr>
<tr>
<td>Pulmonary stenosis</td>
<td>6</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Aortic stenosis</td>
<td>3.5</td>
<td>6.5</td>
<td>5</td>
</tr>
<tr>
<td>Truncus arteriosus</td>
<td>2.7</td>
<td>0.5</td>
<td>—</td>
</tr>
<tr>
<td>Tricuspid atresia</td>
<td>1</td>
<td>1.5</td>
<td>1</td>
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</tbody>
</table>

DETERMINANTS OF PHYSIOLOGIC FUNCTION

- Sequelae
- Complications
- Palliation
- Correction

DEMOGRAPHICS OF CHD IN USA

- 21,000-43,000 live births annually
- 20,000 cardiac surgical procedures
- Over 80% survival to third decade
- Prevalence 500,000-800,000
- Heterogeneous population

COMMON SEQUELAE

- Arrhythmia
- Ventricular dysfunction
- Hemodynamic disturbance
- Pulmonary vascular disease
DETERMINANTS OF PHYSIOLOGIC FUNCTION

- Sequelae
- Complications
  - CNS
  - Renal
  - Hematologic

DETERMINANTS OF PHYSIOLOGIC FUNCTION

- Sequelae
- Complications
- Palliation
  - e.g. single ventricle & Fontan

DETERMINANTS OF PHYSIOLOGIC FUNCTION

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OBJECTIVES

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SURGERY IN ADULTS WITH CHD

- Labor and delivery
- Trauma
- Orthopedic surgery
- General surgery
- Cardiac surgery

DESIABLE HEMODYNAMIC OBJECTIVES

<table>
<thead>
<tr>
<th>Preload</th>
<th>PVR</th>
<th>SVR</th>
<th>HR</th>
<th>Contractility</th>
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</thead>
<tbody>
<tr>
<td>ASD (L→R)</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td>N</td>
</tr>
<tr>
<td>PDA (L→R)</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td>N</td>
</tr>
<tr>
<td>VSD (L→R)</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td>N</td>
</tr>
<tr>
<td>VSD (R→L)</td>
<td>N</td>
<td>↓</td>
<td>↑</td>
<td>N</td>
</tr>
</tbody>
</table>

| AS | ↑ | N | ↑* | ↓* | N↑ |
| IHSS | ↑ | N | N↑ | ↓* | ↓* |
| Valvar PS | ↑ | ↓ | N | ↓ | ↑ |
| Infundibular PS | ↑ | ↓ | N | ↓ | ↓* |
| Coarctation | ↑ | N | ↓ | N | N |
| MS | ↑ | N↓ | N | ↓* | N↑ |
| MR | ↑ | N↓ | ↓ | N↑ | N↑ |
| AI | ↑ | N | ↓ | N↑ | N↑ |

* overriding consideration

ANESTHETIC MANAGEMENT

- More important to be guided by a safe, familiar, established anesthetic technique than to have a detailed understanding of the specific pathophysiologic lesion

SURGERY IN CHILDREN WITH CHD

- Dental procedures
- General surgery
- Urology
- Trauma
- Orthopedic surgery

CHOP NON-CARDIAC SURGERY 2004

- Requests 945/CVA 424
- PS II (154), PS III (195), PS IV (75)
- Elective (400), emergency (24)
- Day Surgery (274), overnight stay (150)
- Simple procedures (60%) – BMT, T/A, circumcision, hernia
- Complex procedures (40%) – TEF, brain tumor, tumor resection, transplant, etc

ANESTHETIC MANAGEMENT

- Patient evaluation
- Cardiologist communication
- Perioperative plan
  - Preoperative goals
  - Postoperative expectations
- Physiologic anesthetic
EVALUATION OF CARDIAC STATUS

- Activity tolerance
- Growth pattern
- Congestive heart failure
- Magnitude of cyanosis
- Medications
- Cardiologist evaluation

FORMULATION OF AN ANESTHETIC PLAN

- Patient considerations
- Operative considerations
- Postoperative considerations

PATIENT CONSIDERATIONS

- Associated conditions – e.g. Chr 22
- Airway – e.g. tracheal stenosis
- Psychosocial issues – e.g. depression
- Medications
- Hematocrit – e.g. cyanosis

OPERATIVE CONSIDERATIONS

- SBE prophylaxis – e.g. AHA
- Monitoring – e.g. BP, ECG, Pulse Ox
- Vascular access – e.g. CVP, A-line
- Positive pressure ventilation – e.g. VR
- Laparoscopy
  - Insufflation, Trendelenberg
  - VR & PBF, emboli & R->L shunts
- Single lung ventilation
  - Cyanosis, PBF, AV malformations

POSTOPERATIVE CONSIDERATIONS

- PACU vs ICU
- Patient comfort
  - Pain – SVR & PVR changes, neuraxial analgesia
  - N&V – fluids
- Fluid management

CONCLUSIONS

- Physiologic spectrum wide
- Expected outcome of a specific lesion and sequelae
  - (Arrhythmia, ventricular dysfunction, hemodynamic residua, pulmonary vascular disease)
- Formulation of anesthetic plan
- Response to provocative conditions
  - general
  - Specific
- Successes in surgery create later challenges for anesthesiology