Pediatric Therapeutic Catheterization

Stuart Berger, M.D.
Director, Heart Center
UC Davis Children’s Hospital
May 2, 2015
Therapeutic Catheterization

- Balloon atrial septostomy (echo guidance)
- Pulmonary and aortic valve dilatation
- Arch and pulmonary artery dilatation
- Stenting: pulmonary arteries/coarctation
- Coil Embolization
- Intravascular Devices:
  - Patent ductus arteriosus
  - Atrial septal defects
  - Patent foramen ovale
  - Ventricular septal defects
Therapeutic Catheterization

- Percutaneous placement of valves
  - Pulmonary (Melody, others)
  - Aortic
- Miscellaneous procedures
Balloon Atrial Septostomy

“Creation of an Atrial Septal Defect without Thoracotomy”
Dr. William Rashkind, Philadelphia
J.A.M.A., 1966
Transposition of the Great Arteries

- Pulmonary artery
- Aorta

Mixing sites:
- Ductus arteriosus
- Atrial septal defect
- Ventricular septal defect

Head

Legs

Transposition of the Great Arteries
Balloon Atrial Septostomy in Transposition of the Great Arteries
Balloon Valvuloplasty

“Percutaneous Balloon Valvuloplasty: A New Method for Treating Congenital Pulmonary Valve Stenosis”
Dr. Jean Kan, Baltimore
N.E.J.M, 1982
Transcatheter Balloon Valvuloplasty

The use of balloons to relieve valve obstruction
Critical Pulmonary Valve Stenosis

Obstructed pulmonary valve

RV

Pre-dilatation Lateral projection
Transcatheter Pulmonary Balloon Valvuloplasty

- Balloon guides
- Balloon catheter
- Calibration guides
- Amplatz guide wire
Aortic Valvuloplasty

Results generally less predictable

Issues:

- Increased risk, dysrhythmia and rupture
- Aortic insufficiency
- Technically, more challenging
- Period of no cardiac output
The **Continuum** of Aortic Valve Disease

- Hypoplastic Left Heart Syndrome
- “Critical” Neonatal Aortic Valve Stenosis
- Aortic Valve Stenosis
- Bicuspid Aortic Valve
- Fused Trileaflet Aortic Valve

“The **worst** congenital heart abnormality is aortic valve disease, because it is never cured”

R.D. Rowe, Hospital for Sick Children
Fused Commissure

Stenotic Trileaflet Aortic Valve
Unicuspid Aortic Valve
Balloon Arterioplasty

“Transluminal Treatment of Arteriosclerotic Obstruction”
Dr. C.T. Dotter and M.P. Judkins,
Circulation, 1964
Transcatheter Arterioplasty

Left pulmonary artery narrowing
Transcatheter Arterioplasty

Left pulmonary artery post balloon dilatation
Intravascular Stenting

Pediatric Indications:

- Pulmonary arteries in pulmonary atresia
- Coarctation of the aorta
- Systemic veins
- ? Pulmonary veins
Vascular Stenting

Advantages:

- Enables opening of elastic and rigid vessels
- Reduced risk of vessel wall damage, dissection, rupture or aneurysm formation

Disadvantages:

- Generally applicable only in older children/adults
- Technically challenging to perform
Palmatz Stent on Balloon Catheter
Superior vena caval obstruction
Stent dilatation of superior vena caval obstruction
Superior vena caval obstruction relieved after stent placement
Coarctation of the Aorta
Juxtaductal Coarctation of the Aorta

AAo

Coarctation

DAo
Juxtaductal Coarctation

Palmatz stent in position
Juxtaductal Coarctation

Angiogram following relief of coarctation
OCCLUSION OF BLOOD VESSELS
Indications for Transcatheter Occlusion

- Patent ductus arteriosus
- Secundum atrial septal defects
- Patent foramen ovale in cryptogenic stroke patients
- Fenestrated Fontan
- Apical muscular VSD’s
- Coronary-cameral fistulae
- Selected aortico-pulmonary connections
Coil Embolization
Coil Embolization

Gianturco coils
Patent ductus arteriosus

Aorta

Pulmonary artery

LA (Left Atrium)

LV (Left Ventricle)

RV (Right Ventricle)

RA (Right Atrium)
Lateral angiographic view of a moderate sized patent ductus arteriosus
Antegrade approach to ductal occlusion
Amplatzer Duct Occluder

- Nitinol basket
- Delivery sheath
- Dacron filaments
Amplatzer Duct Occluder

Screw-in attachment mechanism
Positioning of the Amplatzer Ductal Occluder
The Amplatzer Ductal Occluder in position prior to release of the retention cable.
ASD Occlusion
Atrial Septal Defects

Indications for Operative Intervention

- Symptomatic congestive heart failure
- Prevention of right heart volume overload and subsequent dysfunction
- Pulmonary hypertension
- Predisposition to pulmonary infection
- Paradoxical emboli
## Frequency Distribution of Congenital Cardiac Abnormalities

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular septal defects</td>
<td>32.1%</td>
</tr>
<tr>
<td>Pulmonary valve stenosis</td>
<td>9.0%</td>
</tr>
<tr>
<td>Atrial septal defects</td>
<td>7.7%</td>
</tr>
<tr>
<td>Atrioventricular septal defects</td>
<td>6.4%</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>6.8%</td>
</tr>
<tr>
<td>D-transposition</td>
<td>4.7%</td>
</tr>
<tr>
<td>Coarctation of the aorta</td>
<td>4.6%</td>
</tr>
<tr>
<td>Hypoplastic left heart syndrome</td>
<td>3.8%</td>
</tr>
<tr>
<td>Aortic stenosis</td>
<td>2.9%</td>
</tr>
<tr>
<td>Patent ductus arteriosus</td>
<td>2.4%</td>
</tr>
<tr>
<td>Others</td>
<td>19.6%</td>
</tr>
</tbody>
</table>
Atrial Septal Defects

4 sub-types
Amplatzer “Nitinol Basket” Occluder Device

- 2 opposing flat baskets, joined by a central hub, all woven with fine Nitinol wire
- Variable size connecting hub
- Filled with Dacron or polyurethane strands

Potential problems:
- High profile position
- Wire exposure
Amplatzer ASD Device

Left Atrial Aspect

Right Atrial Aspect

Waist

Releasing Cable

Nitinol Basket filled with Dacron threads
Amplatzer Septal Occluder

Nitinol Basket filled with Dacron threads
Amplatzer Septal Occluder being extruded from sheath
Color Doppler of secundum ASD
Sizing the Atrial Defect
Amplatzer device being positioned within the atrial defect
“Minnesota Wiggle”

LA

RA

Release cable
Amplatzer device positioned and released within the atrial defect
Long axis view of Amplatzer device positioned within the atrial defect
AND COMING SOON!!!!
Melody Valve
The Role of RVOT Valvar Competency

• Infant cardiac repairs benefiting from RVOT competency.
  ♥ Tetralogy of Fallot
  ♥ Pulmonary atresia with VSD
  ♥ Absent pulmonary valve syndrome
  ♥ Ross repair
  ♥ Truncus arteriosus
  ♥ DORV, TGA – Rastelli

12-15% of CHD
Conclusions

❤ The Cath lab has become a very specialized place.
❤ Echocardiography remains the gold standard for initial diagnosis and is integral in performance of interventional procedures.
❤ Interventional catheterization continues to grow.
Conclusions

Current therapeutic catheterization procedures that are accepted as the standard of care:

- Balloon dilation of pulmonary valve
- Balloon dilation of recurrent coarctation
- Balloon dilation/stenting of pulmonary arteries
- Percutaneous valve placement
Conclusions

Cath procedures that are accepted as standard of care:

- Stenting of recurrent coarctation
- Coil occlusion of PDA
- Device occlusion of PDA
- Device occlusion of secundum ASD
- Device occlusion of muscular VSDs
- Device occlusion of PFO
THANK YOU VERY MUCH!!!!