Echocardiography after Surgery for CHD

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Temporal Trend in all cause mortality in CHD 1987-1988 and 2004-2005

Proportion of all deaths (%)

Age at death (years)

≥90
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
1-4
<1

Year 1987-1988

Year 2004-2005

Proportion of all deaths (%)
No cure after Surgery for CHD
Echo after Cardiac Surgery in CHD

Learning Objectives

1. Familiar with residua and sequaleae
   - Simple and complex
   - Palliation and repair

2. Recognize common post-operative Echo findings

3. When to call a friend: ammash.naser@mayo.edu
62-YO S/P Suture ASD Repair at age18
62-YO S/P Suture ASD Repair in 1965
Atrial Flutter

RVE Post ASD repair

Residual shunt
Missed associated defects
TV regurgitation
Pul. HTN with PR
62-YO S/P Suture ASD Repair at age 18
Atrial Flutter
62-YO S/P Suture ASD Repair at age 18
Atrial Flutter

Residual-recurrent ASD shunt
- Occurs in 5-10%
- Older age at time of operation
- Type of repair
- Progressive pulmonary HTN
41 YO Post AVS defect Repair at age 4

- Syncopal spell at age 20, advised PPM
- Now with severe dyspnea
Long term outcome in partial AVSD in 334 pts

• Survival
  • 93% at 10 yrs
  • 76% at 40 yrs

• Reoperation in 11%
  • LVOT obstruction in 2%
  • Mitral regurgitation in 9%

• Atrial arrhythmias in 16%
  • More if older age at operation
16 YO S/P VSD Repair
Loud Systolic Murmur
16 YO S/P VSD Repair
Loud Systolic Murmur
Double Chambered Right Ventricle

- Subpulmonic obstruction:
  - Hypertrophied trabeculations /septo-marginal band
  - Anomalous apical shelf

- Repair depends on symptoms and gradient
  - Cardiac catheterization often needed
Repaired VSD
Residua and Sequelae

- Residual VSD up to 20%
- Aortic regurgitation up to 20%
- Tricuspid regurgitation up to 27%
- Double chambered RV
- Pulmonary HTN
- Infective endocarditis < 2 / 1000 pt.yr
- Complete heart block 1 - 2%
- Atrial arrhythmias 5 - 23%

Late reoperation
68 old lady S/P CoA patch repair at age 13
Survival after Coarctation Repair
819 patients (1946-2005)

Patients with coarctation repair

Age & gender matched population

Survival (%) vs. Follow-up (years)
P < 0.001

Brown M, JACC 2013
54 re-operations in 43 pts

Spectrum of Reoperations After Repair of Aortic Coarctation: Importance of an Individualized Approach Because of Coexistent Cardiovascular Disease

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- **Objective**: To determine the indications for and spectrum of late reoperations in adults who had previously undergone coarctation repair.
- **Patients and Methods**: We reviewed clinical, cardiac catheterization, and echocardiographic data and criteria for reoperation, surgical procedures, and outcome in 43 patients who underwent 54 reoperations between 1972 and 1996.
- **Results**: Of the reoperations for recoarctation or associated cardiovascular disease (or both), 20% were performed in asymptomatic patients and 80% in symptomatic patients. Associated cardiovascular disease included bicuspid aortic valve in 36 patients (84%), aortic arch hypoplasia in 12 (28%), true or false aortic aneurysm in 6 (14%), mitral valve disease in 6 (14%), and subvalvular aortic stenosis in 5 (12%). Surgical procedures included 22 recoarctation repairs and 32 other cardiovascular interventions. Simultaneous repair of recoarctation and associated cardiovascular disease was performed as a single-stage repair in 5 reoperations through a median sternotomy using an extra-anatomic, ascending-to-descending aortic bypass, with no complications. One patient died (surgical mortality, 1.9%) of preexisting severe pulmonary vascular obstructive disease.
- **Conclusions**: After coarctation repair, associated cardiovascular diseases are the most common cause for reoperation. An individualized surgical approach is important and may range from valve replacement or recoarctation surgery to extra-anatomic bypass combined with other cardiovascular procedures, enabling simultaneous repair of recoarctation and associated lesions. Despite complex surgical techniques and multiple reoperations, morbidity and mortality were low in our series.

*Mayo Clin Proc. 2002;77:646-653*
60 yr old survivor of repaired TOF
Chest Pain

- Repaired TOF at age 10
- DM, HTN, OSA, COPD
60 yr old survivor of repaired TOF

Myocardial Infarction
60 yr old survivor of repaired TOF
CABG day 5

Dismissed home on day 26
Pulmonary regurgitation severity

Color Doppler

- **Mild**: PR noted in RVOT not PA
- **Moderate**: PR noted in the main PA
- **Severe**: PR noted in the branch PAs
Pulmonary Regurgitation severity
PW or CW Doppler

Mild PR: Holo-diastolic

Severe PR: Abbreviated PR signal
PR post rTOF: Indication for Intervention

- Symptoms or failed CPX
- $RVEDV > 150 \text{ cc/m2}$
- $RVESV > 80 \text{ cc/m2}$
- *Moderate or more RVD; EF<45%*
- EF<55% or low CO
- PS/PR with PAP 2/3 systemic or PG $\geq 80$
- *Branch PS with <30% flow to affected segment*
- Arrhythmias: Ventricular $>$ atrial
- Residual lesions: TR, AR, VSD
CTA in Congenital Heart Disease

- Excellent tool for evaluation of vascular structures
  - Aorta, PA, coronaries, fistula, aneurysm
- Alternative assessment of prosthesis
  - Leaflet motion, Thrombus or Pannus
  - Perivalvular leak
d-TGA post Atrial Switch
Mustard vs Senning

- Ake Senning: autologous tissue
- William Mustard: synthetic material

Differences are subtle and not easily recognized by noninvasive or invasive imaging
d-TGA post Atrial Switch
Long-Term Survival: 113 Mustard pts
80% at 20 years

Survival Free (%)

Death (sudden) (n=8)
Death (known cause) (n=19)
Arrhythmia (n=70)

Post-Op Evaluation: Atrial Switch Operation
Role of Echocardiography

• Systemic RV dysfunction 90%
• Systemic AVV regurgitation 40%
• Baffle obstruction 30%
  • Mustard: SVC > IVC > Pulmonary venous
  • Senning: Pulmonary > systemic veins
• Baffle leak 25%
• Sub–PS (fixed or dynamic) 25%
• Pulmonary HTN 10%

Consider calling a friend
34 YO S/P Mustard Procedure

Parallel course of great arteries
34 YO S/P Mustard Procedure
30 YO S/P Mustard procedure at age 2
34 YO S/P Mustard Procedure
32 YO S/P Mustard with CHF
Echocardiography after Surgery for CHD

Take Home Message

- Survival into adulthood expected in >90% of patients
  - No cure after surgical repair of CHD even simple CHD
  - Many have residua and sequelae
  - Need to know what you are looking for in postop CHD
    - Many are symptoms free
    - Re-intervention common
- Key role for Echo in identification of residua and sequelae
  - Incremental value for Cardiac MR and CT
Echocardiography after Surgery for CHD

When to Call a Friend

1. Known CHD history and have not seen or imaged such patients in the past:
   a. Tetralogy of Fallot, truncus arteriosus, pulm. atresia
   b. Transposition of Great Arteries
   c. Tricuspid atresia with or without Fontan
   d. Mustard, Senning, Rastelli, Jatene, Fontan, hemi-Fontan, Konno, Takeuchi

2. Unknown CHD history
   a. Something not normal
   b. Something missing
Thank You!

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