Common Surgical Procedures for Congenital Heart Disease

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Definitions & a reality check

Malformation
A primary structural defect arising from a localized error in morphogenesis - results in the abnormal formation of an organ

Dysplasia
Refers to an abnormal organization of cells into tissues - results in abnormal tissues

The distinction of a malformation from a dysplasia is at best blurry . . . there is much overlap

Repair
Complete anatomic correction of congenital heart defect

Palliation
Provides physiologic correction of blood flow

Normal cardiac circulation

The right and left sides are normally separate circulations separated by the pulmonary capillary bed

Intracardiac & extracardiac shunts

In utero - 2 normal shunts

Foramen ovale
Ductus arteriosus

Postnatal abnormal shunts

ASD  VSD  PDA
Truncus arteriosus

Patent ductus arteriosus

Division & over-sewing
1938
Gross – Children’s Hospital Boston

Triple ligation technique
1946
Blalock – Johns Hopkins

Pharmacologic closure
1976
Indomethacin
Heymann

Performed when he was Chief Resident & his surgical chairman was out of town!

Patent ductus arteriosus

Post-surgical findings, complications & re-op indications

Essentially none

Need for re-imaging

Virtually none
**atrial septal defect**

- **closed technique**
  - late 1940s & early 1950s
  - Bailey & Søndergaard (separately)
- **open repair technique**
  - 1952
  - Gross – Children’s Hospital Boston
- **direct visualization**
  - 1953 – Lewis & Taufic
  - using cardiopulmonary bypass
  - 1954 – Gibbons
- **Amplatzer device closure**
  - 1997 – Matsura

**atrial septal defect**

- **patent foramen ovale**
  - closes as left heart pressures increase postnatally
  - *primum*
  - *secundum*
  - *sinus venosus*

**atrial septal defect**

- **post-surgical findings, complications & re-op indications**
  - essentially none
  - need for re-imaging
    - virtually none
  - residual ASD

**ventricular septal defect**

- **PA banding – palliation of VSD**
  - 1952 – Muller & Dammann
- **VSD closure**
  - 1954 – Lillehei – U of Minnesota
  - using a heart-lung machine
  - 1955 – Kirklin – Mayo Clinic
- **transatrial closure**
  - 1958 – Stirling
- **total circulatory arrest**
  - 1969 – Okamoto
- **deep hypothermia & arrest**
  - Barratt-Boyes
- **Amplatzer closure device**
  - 1999 – Thanopoulos

**ventricular septal defect**

- **post-surgical findings, complications & re-op indications**
  - essentially none
  - need for re-imaging
    - virtually none
  - residual VSD

**ventricular septal defect**

- **membranous**
- **paramembranous**
- **muscular**
- **single**
- **multiple**
- **spontaneous closure**
Prosthetic conduit between subclavian & PA
1962
Kilner – refined by Leval
BT shunt ipsilateral to the aortic arch
Laks and Castaneda
DAo to PA shunt
1946 – Potts
Central aortopulmonary shunt
1955 – Davidson
AAo to PA shunt
1962 – Waterston

TOF – PA atresia – PA stenosis
in utero
blood flow is supplied to the lungs via the ductus arteriosus
post natal
pulmonary vascular resistance is high
requires arterial pressure to perfuse the lungs
ductus arteriosus closes... or... maintained opened with PGE

Blalock-Taussig shunt – classic
developed for ‘blue babies’
1945
Blalock & Taussig (& Thomas)
Johns Hopkins

Blalock-Taussig shunt – modified
developed for ‘blue babies’
1945
Blalock & Taussig (& Thomas)
Johns Hopkins

trans-annular patch
augmentation of the RVOT & enlargement of the MPA
1986 – Kirklin

trans-annular patch
surgical complications
inadequate relief of obstruction
pulmonary insufficiency
need for re-imaging
restenosis of RVOT branch PA stenosis
RV failure due to PI
Hypoplastic left heart syndrome

all left sided structures are small
mitral valve
left ventricle
aortic valve
ascending aorta
coronary artery perfusion is via retrograde flow from the ductus arteriosus through the ascending aorta

Norwood procedure

staged surgical procedures toward goal of Fontan circulation palliation of HLHS
neo-aorta & BT shunt are created anastomosis of MPA to AAo limit pulmonary blood flow ASD – created or enlarged bidirectional cavo-pulmonary shunt venous pressure to lungs

Glenn shunt

circulatory bypass of the R heart
1958
Glenn – Yale

permanent shunt intended to palliate hypoplasia of R sided structures
unilateral
bilateral
bidirectional
used to augment PA blood flow after PA pressures have normalized
Glenn shunt

post-surgical findings, complications & re-op indications
- thrombosis
need for re-imaging
- confirming patency
- assessment of pulmonary blood flow

Fontan circulation

Superior and inferior vena cavae anastomosis to the PAs
1971
Fontan – University of Bordeaux

Fontan circulation

Multi-staged procedure to palliate tricuspid atresia, single ventricle syndromes [HLHS, HRV with PA atresia]
total cavopulmonary connection
returns systemic venous blood flow to the lungs separate from right heart contractions
The R & L circulations are separate

Fontan circulation

post-surgical findings, complications & re-op indications
- thrombosis
- pleural effusions
- ascites
need for re-imaging
- confirming patency
- assessment of pulmonary blood flow

Damus – Kaye – Stansel

Anastomosis of AAo & MPA & RV to PA conduit
1975 – Damus
1975 – Kaye
1975 – Stansel

Damus – Kaye – Stansel

correction of TGA with single ventricle physiology – or single ventricle repair – HLHS
the MPA is transected and anastomosed with the AAo
**Damus – Kaye – Stansel**

*post-surgical findings, complications & re-op indications*

- thrombosis
- need for re-imaging
- confirming patency of DKS anastomosis and coronary arteries
- patency of BT & Glenn shunts

**Transposition of the great arteries**

- **D – TGA**
  - AV concordance
  - VA discordance
  - parallel circulations requires mixing - shunt

- **L – TGA**
  - AV discordance
  - VA discordance
  - 2 wrongs do not make a right

**Transposition of the great arteries**

- **D – TGA**
  - AV concordance
  - VA discordance
  - parallel circulations requires mixing - shunt

- **L – TGA**
  - AV discordance
  - VA discordance
  - 2 wrongs do not make a right

**Jantene arterial switch**

- correction of D loop TGA at the arterial level
- physiological correction of D-TGA
- the aorta and MPA are switches and the coronary arteries are reimplanted into the neo aorta

**Jantene arterial switch**

- post-surgical findings, complications & re-op indications
  - tension on great vessels & reimplanted coronary arteries
  - need for re-imaging
  - coronary artery origin stenosis
Le Compte Maneuver
maneuver to minimize kinking of the coronary arteries which can be a complication of the arterial switch Jatene procedure. Pulmonary arteries are draped over the AAo.

Rastelli procedure
correction of TGA with VSD and LVOT obstruction. RV–PA conduit is also used for PA atresia, TOF.

RV-PA conduit
used to direct RV blood flow to the PAs when 2 ventricle repair of DORV or HLHS is performed. Bovine pericardial conduit or artificial graft material from the RV to the PAs. Pulmonary insufficiency, Calcification & stenosis of the conduit, RV dilatation.

Rastelli procedure
post-surgical findings, complications & re-op indications:
- Thrombosis
- Pleural effusions
- Ascites

Need for re-imaging:
- Conduit stenosis
- Pulmonary insufficiency
- RV hypertrophy & failure.
PA banding

- circumference of band (mm) = child's weight (kg) + 20
  - Trusler & Mustard

Mustard or Senning – atrial switch

- interatrial baffle
  - 1954 – Mustard using artificial pericardium
  - 1959 – Senning using atrial tissue

double switch

- Physiologic correction of congenitally corrected L-TGA
- Senning or Mustard & Jantene or Rastelli

Ross procedure

- Pulmonic valve moved to the aortic position
  - 1962 – Ross
  - Guys Hospital – London

Ross procedure

- replacement of the aortic valve with the pulmonic valve
  - may include replacement of a portion of the AAo
  - coronary arteries are transferred
  - cadaveric homograft is used to replace the native pulmonic valve

Coarctation of the aorta

- first surgical repair of coarctation of the aorta
  - 1944
  - Crawford – Karolinska Institute
Aorto-aorto bypass graft

used to palliate interrupted aortic arch

OR

to supplement repaired coarctation of the aorta

Coarctation of the aorta — surgical

End – to – end anastomosis

most often performed during the first year of life
tissues are more elastic, so bringing ends together is successful

may be an oblique anastomosis

Patch repair

performed at any age

Coarctation of the aorta — stent

Interventional – catheter based repair

angioplasty & stenting to dilate coarctation of the aorta

beware of jailing of the left subclavian artery origin

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