Atrial Septal Defect:

A Brief History, Indications and Techniques for Repair
HPI:

**70F** with an Atrial Septal Defect (ASD), referred for elective repair by her cardiologist.

Symptoms included **recurrent pneumonia/chest congestion (twice)** and **exertional dyspnea**, which progressed to moderate severity over the preceding year.

Diagnosis of murmur was made at age 21 in Barbados, further investigation deferred given asymptomatic presentation.
PMH/PSH: Glaucoma, cataract, cervical ca, c-section
Meds: none
NKDA
Social: negative
Family: negative

Physical Exam:

Gen: NAD, thin, well nourished, well groomed
Chest: clear with soft bibasilar rales
Cardiac: Fixed split S2
Echocardiography

Large *sinus venosus defect (1.7cm)* with left to right shunt.

**Flattened septum during systole**, indicating RV overload.
**Increased RV wall thickness** with normal function.

Mildly accelerated transpulmonic velocity.
Moderately elevated *PA systolic pressure at 51.2 mmHg*
*(Normal peak <40, mean < 25 mmHg)*
Cardiac Catheterization

Right Heart Cath

*Pulmonary pressures:* 39/29, **mean 31 mmHg**

- **Wedge:** 18
- **CO:** 2.6
- **CI:** 1.6
- **Qp:Qs = 4**
- **Qp:Qs = 1.6**

Left Heart Cath

*Coronary circulation:* no evidence of disease

- **EF:** 55%

Aorta 90%

- IVC 66%
- LA 87%
- PA 82%
- RA 84%
- RV 83%
- SVC 59%

Borer Paper
OR

Median Sternotomy

Aortic and Bicaval cannulation

Cardiac arrest

Right Atriotomy, extending laterally into the SVC

(to avoid SA node)
OR

Sinus Venosus Defect Identified at the **SVC border**

**No anomalous pulmonary venous return**

Bovine pericardial patch, secured with running 4-0 prolene

Atriotomy closed

Rewarming, Cardioversion, Removal of cannulae
Postoperative Course
Uncomplicated
Transferred to inpatient rehab unit POD 4

Readmission
Supraventricular tachycardia on POD 4
Chemical cardioversion → Junctional Rhythm
Pacemaker placed
Discharged directly home POD 18
Illustration of the atrial well method to close ASD as described by Robert Gross in 1952.
Terminology
E 25–30 mm

F 100 mm to birth
Terminology
Types of Atrial Septal Defects

**Patent foramen ovale**

Failure of septum primum and secundum to fuse

965 Autopsy: 27% of adults had a PFO

- <29 = 1/3 have PFO
- 30-79 = 1/4 have PFO
- >80 = 1/5 have PFO

**Secundum ASD** ~ 1/1500 live births

- 4-5mm: most close spontaneously
- 8mm: generally enlarge
- >10mm: don’t close
- within fossa ovalis
Types of Atrial Septal Defects

**Prium ASD**
Inferior aspect of atrium
Associated with VSD
Cushion defect

**Coronary Sinus Type**
Unroofed coronary sinus in the left atrium
Associated with valve malformations
Types of Atrial Septal Defects

Coronary Sinus Type

- Fenestrations in the roof of coronary sinus
- There can be two way communication between LA and CS
- ASD / PFO may be present

Modified image from Niigata University School of Medicine
www.drsvenkatesan.com
Types of Atrial Septal Defects

Sinus Venosus

Not in the fossa ovalis
Superior or inferior defect
Partial anomalous pulmonary venous return ~50%
  74% right upper PV/SVC

**show video
Key Concepts

**Shunt**
Physiologic to pathophysiologic
Key Concepts

Shunt
Key Concepts

Shunt
Physiologic to pathophysiologic

Shunt fraction: Pulmonary Flow: Systemic Flow
Qp:Qs  
> 1.5 to 1 = repair
<1.5 to 1 = high risk / don’t

Evolution of a shunt

ASD 6mm or larger will cause a significant shunt altering RV mechanics
Qp (pulmonary blood flow) = \( \frac{VO_2}{(C_pvO_2 - C_paO_2) \times 10} \)

Qs (systemic blood flow) = \( \frac{VO_2}{(CaO_2 - C_mvO_2) \times 10} \)

Aorta 90%
IVC 66%
LA 87%
PA 82%
RA 84%
RV 83%
SVC 59%
Key Concepts

At some point you cannot repair
Ideal: age 2-5 years before symptomatic
Reversible pulmonary hypertension
Pulmonary Hypertension 8-12 woods units
Cardiac plasticity

Eisenmenger’s
Reversal of flow
Key Concepts

Right ventricular hypertrophy

Mechanism: Overloaded right side → RVH
Hypertrophy: reduced coronary reserve, dysfunct.

Cardiac plasticity

Pulmonary hypertension

Genetic predisposition
Non laminar flow
Shear stress
Common features at presentation

Early (Child)
Silent and asymptomatic
Detected by murmur

Advanced Disease
Exercise intolerance
Volume overload
Atrial fibrillation
Recurrent respiratory infection
Cyanosis $\rightarrow$ ntd
Common features at presentation

**Advanced Disease**

Steady rise in pulmonary pressure from age 30

Even though asymptomatic may have reduced exercise tol.  
(RV overload)

Age 40 → most become symptomatic

RV dysfunction -- ~ 45 yo

Don’t fix it: **90% die by age 60**
Workup in the adult

**Physical exam**
- Arrhythmia
- Cyanosis
- Parasternal heave
- Fixed split S2

**Studies**
- Right bundle branch block
- Echo: Shunt fraction, RVH, Pa pressures
  - EF? $\rightarrow$ RV bulge, preload
- Right heart cath: Oxygen step offs
- Cardiac MRI
Workup in the adult

Shunt fraction
The reason to becomes the reason not to

To do or not to do (papers on the adult)
If it isn’t a problem at 60....
Atrial septal defect in patients age 60 years or older: operative results and long term postoperative follow up.

Sutton, Tajik and McGoon
Mayo Clinic
Circulation, 1981

Increased 5 and 10 year survival
Downstage heart failure
Operative mortality 6%
Sinus Venosus Atrial Septal Defect

77% had symptomatic improvement
6% had sinus node dysfunction
Age predicts AFib risk
Older actually had greater improvement in symptoms
Closure of secundum atrial septal defects in the adult and elderly patients

Nyboe
Denmark
European journal of cardiothoracic surgery, 2012

Reversal of RV dilatation in patients older than 50 years of age
Myocardial plasticity.
Workup in the adult

Shunt fraction
The reason to becomes the reason not to

To do or not to do (papers on the adult)
If it isn’t a problem at 60....
Age of rv dysfunction.... So why do in 70 yo
Answer = heart failure improves
Indications for Repair

Symptomatic
Hemodynamic significance
Size
Stroke in the young
Divers
Methods of repair

Endovascular

Surgical
Methods of repair

Endovascular

Defect Size (38mm)
Defect Location
  Landing zone
  Valve entrapment
  Proximity to conduction system

Long term outcomes
Methods of repair

Endovascular

Surgical
  How to repair
  Risks
Methods of repair

**Sinus venosus**

Cannot be done with endovascular approach
- Pulmonary vein abnormalities
- Location of Conduction system
- Block SVC outflow
- Size (38mm)
Outcomes

Children < 5yo: 6mo reversal of symptoms, normal lifespan
    > 5 yo: some persistent rv dysfunction

Age 40: < 40yo at time of repair have overall reduction in cardiac events
    >40yo → no clear cut benefit, but:

    15 year follow up found better composite outcome
    Reduction in New York Heart Failure class

Age > 60: improved 5-10yr survival
**Complications**

Atrial fibrillation

- if age > 40 at time of repair then 30-40% stroke from afib
- Consider Maze procedure

Complications of CPB

Dehiscence

RV failure → fenestrate patch
Indications for Repair

Symptomatic
Hemodynamic significance
Size
Stroke in the young
Divers
Thank You