Is One-and-a-Half Better than One?

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No Disclosures

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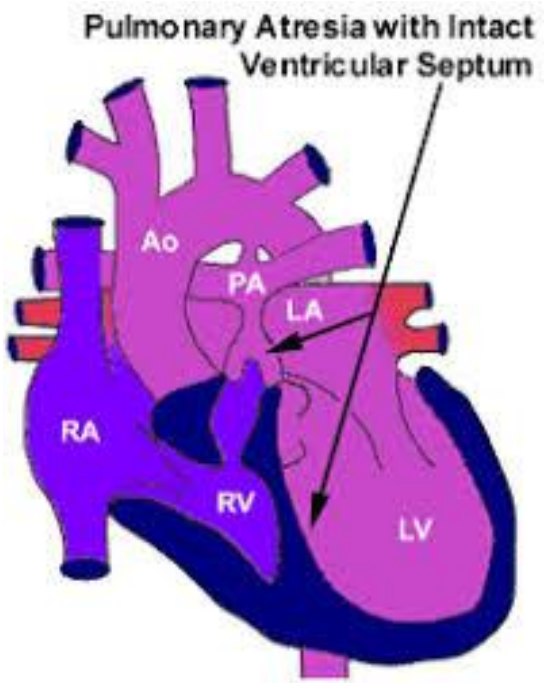
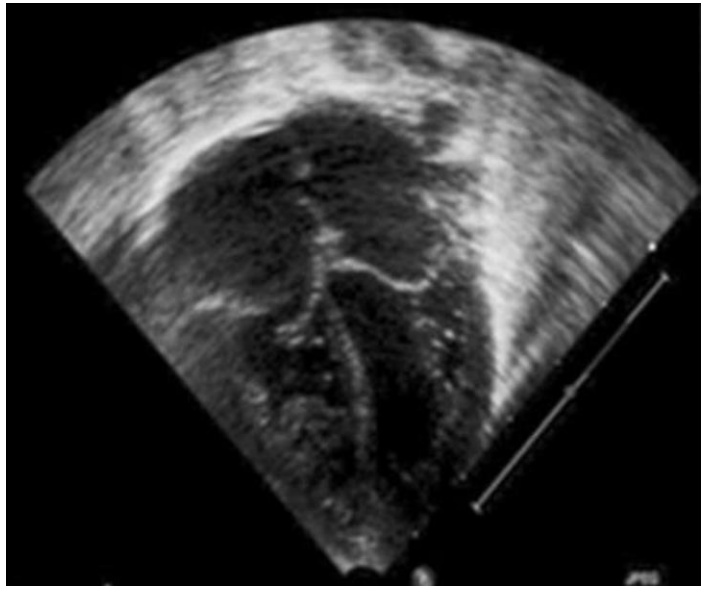
What is One-and-a-Half?

Concept arose from Pulmonary Atresia with Intact Septum – recognition of a spectrum in RV size





<u>Small, muscle-bound RV:</u>

BVR would not work:

RAP too high

If leave ASD then too desaturated

Too good for a Fontan

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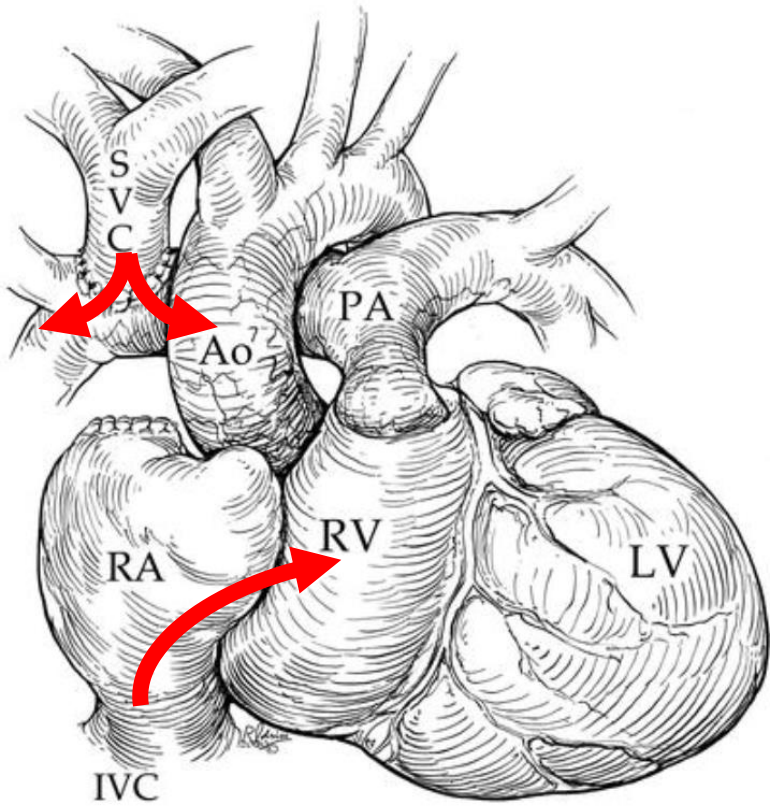
‘Repair’ of Pulmonary Atresia with Intact Septum

Billingsley and Laks, UCLA 1989



. Bidirectional Glenn
. Closure of Atrial Septum*
. Reconstruction of RVOT –
muscle resection/transannular patch/conduit

* Not always!

JTCVS 97:746, 1989

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One-and-a-half vs Fontan

Benefits

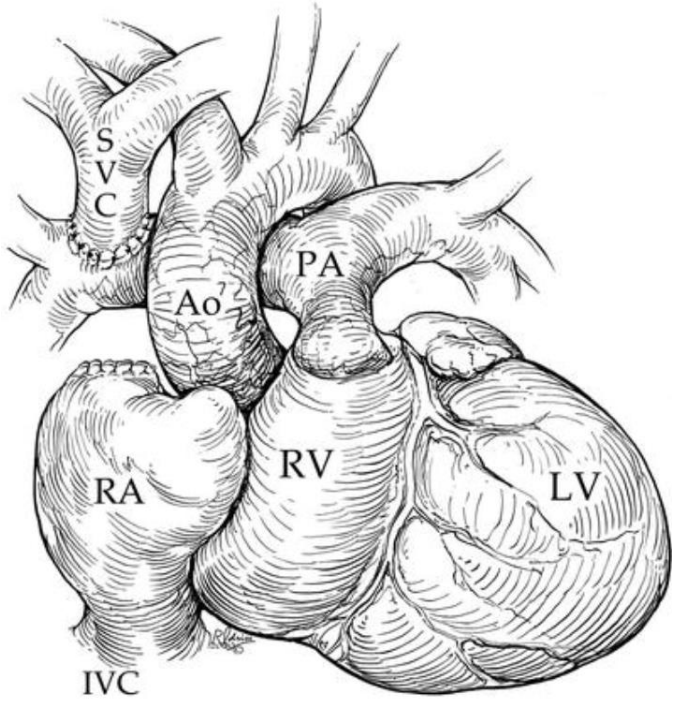
. Maintains a 'pump'
can increase cardiac output

. Pulsatile flow in PAs

. Low pressure in the IVC

. Better exercise tolerance

. Septates the circulation



Unresolved Questions

.How big is big enough?

.What if PA pressure too high?

.Residual ASD or not?

.If not, what is the benefit?

.Is exercise tolerance really better?

.What is the cost in terms of reinterventions?

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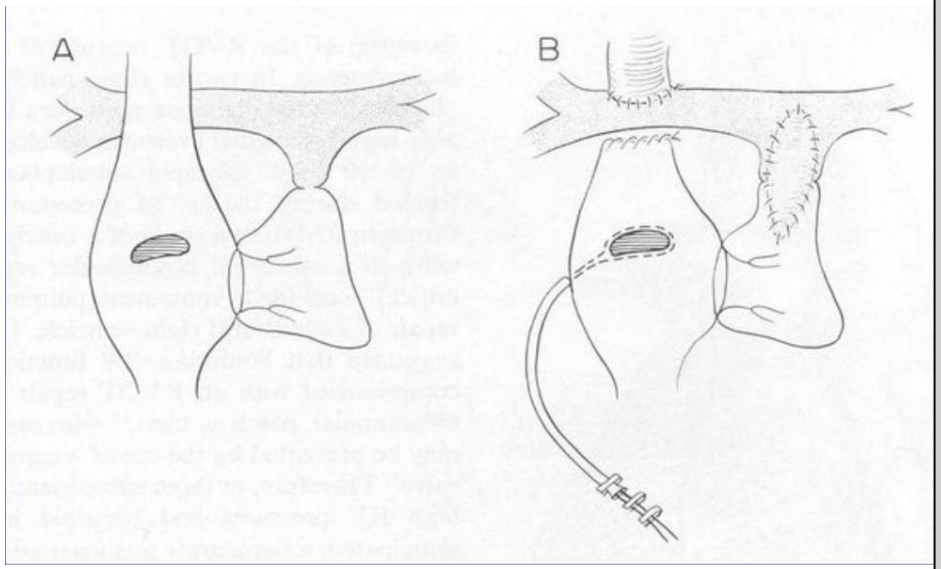
How Big is Big Enough?

TV z-score -2 to -5
TV annulus ≥75% of IVC
RV volume 70% predicted



Other conditions that may have small RV

PAIVS
Ebstein's
Unbalanced AVSD
d-TGA/VSD
ccTGA/VSD
VSD with straddling TV
Critical PS
DORV with small RV

A z-score of -2 to -5 is equivalent to RV volume 50-80% predicted

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One-and-a-Half is not reserved only for the Small RV

Four main indications have emerged

1. **Small RV** ***"Volume Unloading 1 ½ "***
2. **Impaired RV** ***"Work Unloading 1 ½"*** **Typically the enlarged, poor functioning RV in Ebstein**
3. **Acute RV Failure** ***"Salvage 1 ½ "*** **RV failure on table. Failure to separate from bypass.**
4. **Facilitate Complex Repair** ***"Facilitative 1 ½"*** **Often in the setting of good sized RV**

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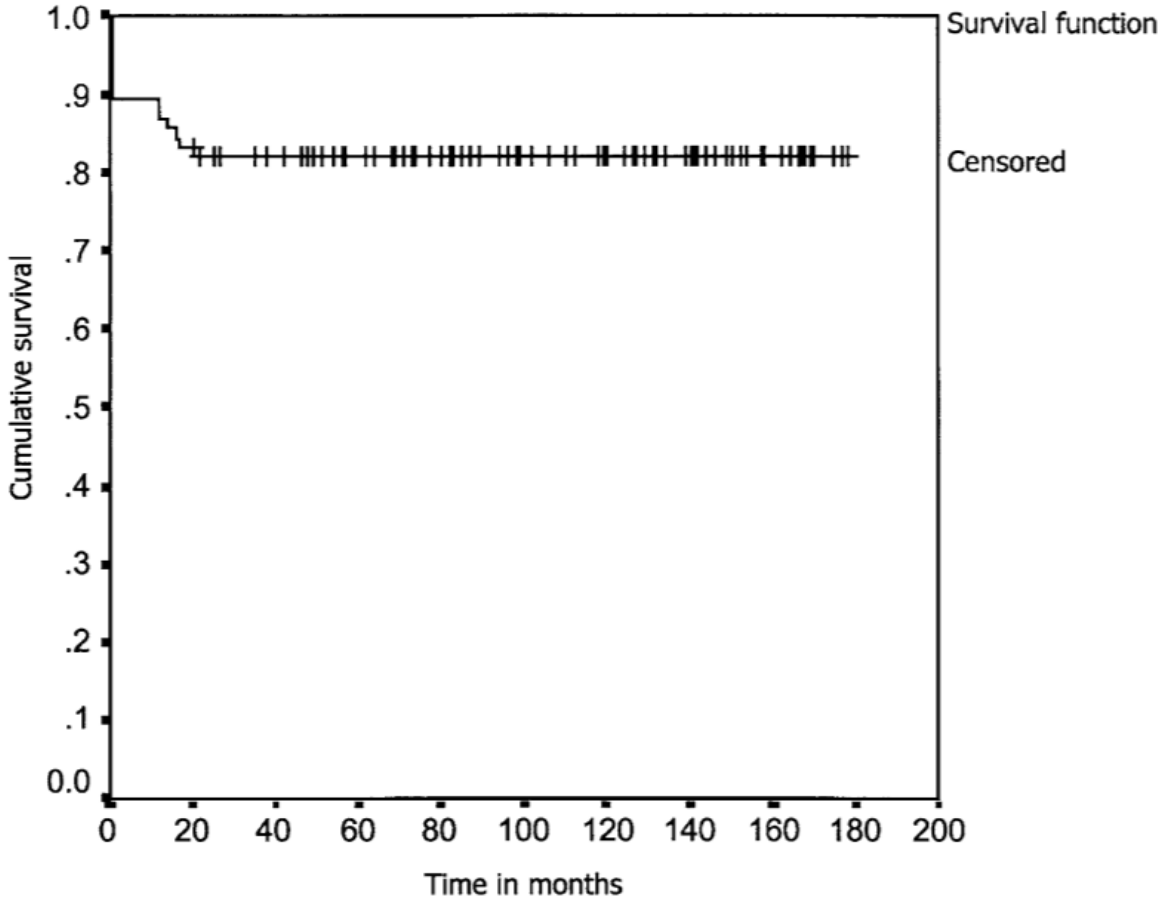
Outcomes of One-and-a-Half Repair



Follow up (months)	0	20	40	60	80	100	120	140	160	180
Number at risk	85	70	63	55	46	37	30	21	10	1

New Delhi ATS 80:2293, 2005

The variable indications confuse results

'Salvage' surgery has 25-75% mortality

'Work Unloading 10-15% mortality

'Volume Unloading' 5-10% mortality

Toronto n=38 ATS 66: 678, 1999
Seoul n=29 EJCTS 39: 711, 2011

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Complications – One-and-a- Half Repair

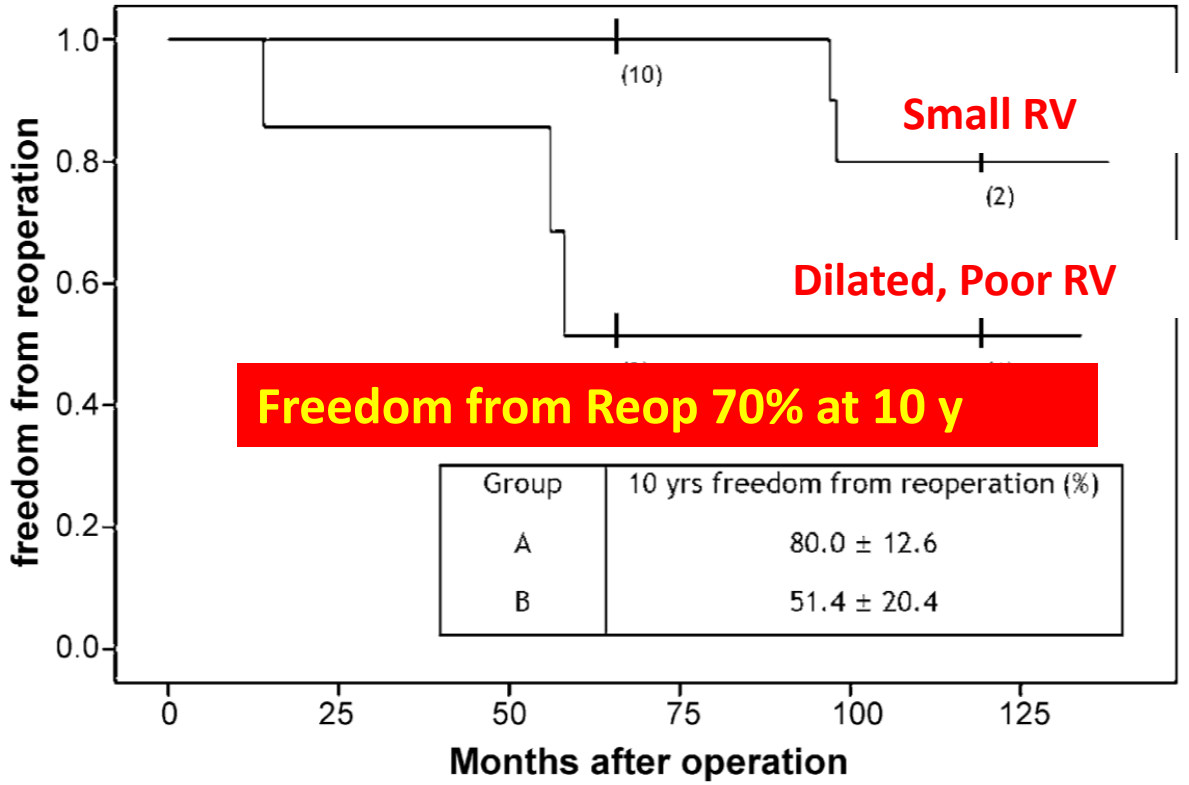
Prolonged pleural effusion & chylothorax

Atrial Tachyarrythmias 12-30% at follow-up

Higher PAP (>15mmHg pre-op) ↑risk

Higher PAP (>20mmHg post-op) ↑risk

Freedom from Reintervention



EJCTS39:711 2011 Seoul

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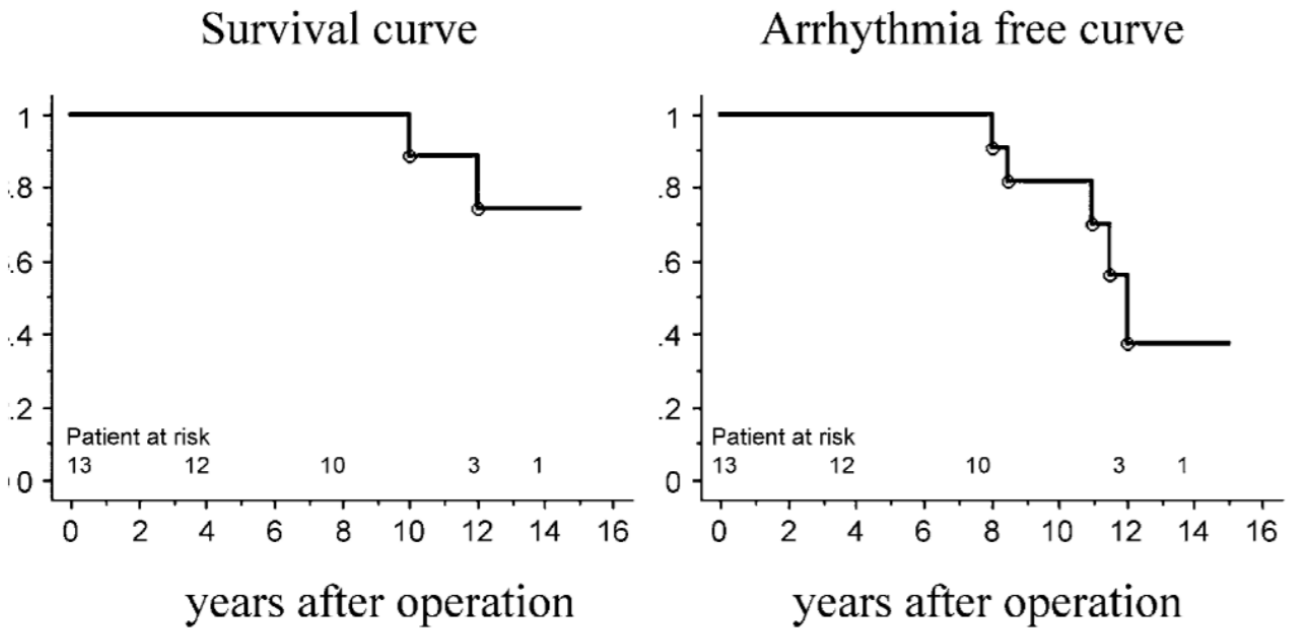
Complications – One-and-a- Half Repair



Smaller the RV: the greater the risk of re-interventions
the greater the risk of arrhythmias

EJCTS 24: 516, 2003

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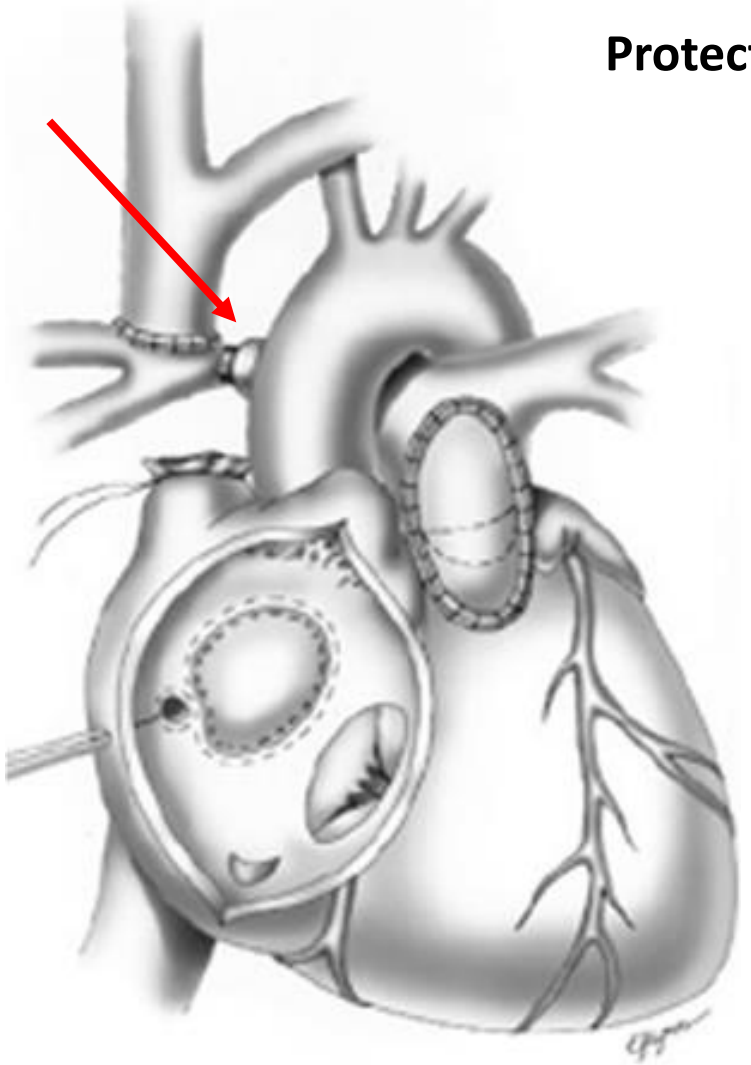
Evolution of the 1 ½ - Proximal RPA Banding



Protects from high pressure – but loss of pulsatile flow

Effect of RPA Band:

	RIGHT lung flow	LEFT lung flow
Standard BDG		
SVC Inflow	**66%**	**34%**
IVC Inflow	**57%**	**43%**
Banded RPA		
SVC Inflow	**88%**	**12%**
IVC Inflow	**45%**	**55%**

Adjustable ASD in selected cases

JTCVS 117: 662, 1999

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The One-and-a Half to Facilitate Surgery

Complex Anatomy: Unroofed L SVC - intra-atrial baffling can be difficult

Complex Surgery: Double Switch, Unroofed SVC in heterotaxy.

Delay need for Conduit: Pulmonary Atresia/VSD
TGA/VSD/PA
Aortic -Atresia/VSD (Yasui)

Especially if : ? Borderline RV Size:
Rastelli, Senning-Rastelli, DORV repair, Ebstein

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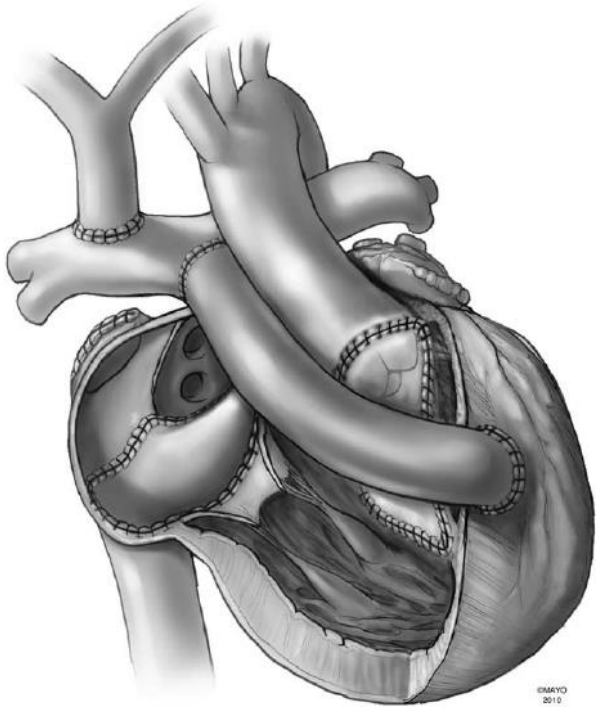
The One-and-a Half Technique in ccTGA



Rastelli-Hemi-Mustard

Simplifies Surgery

Less risk of SVC obstruction

Good option if borderline RV

Also suitable if previous Glenn

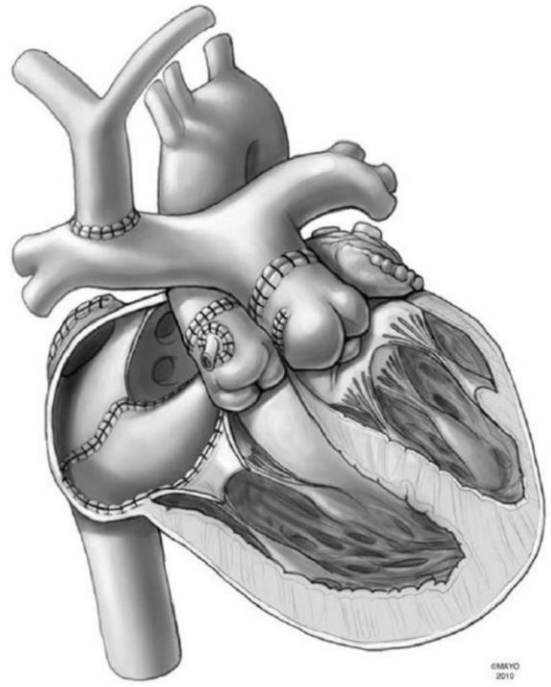
Lengthens conduit survival

Only if PAP is low

Risk of Chylothorax

? Less good functional result

No access for pacing



Double-Switch

The Question here is : Is 1 ½ better than two ??

Images fom Dearani et al

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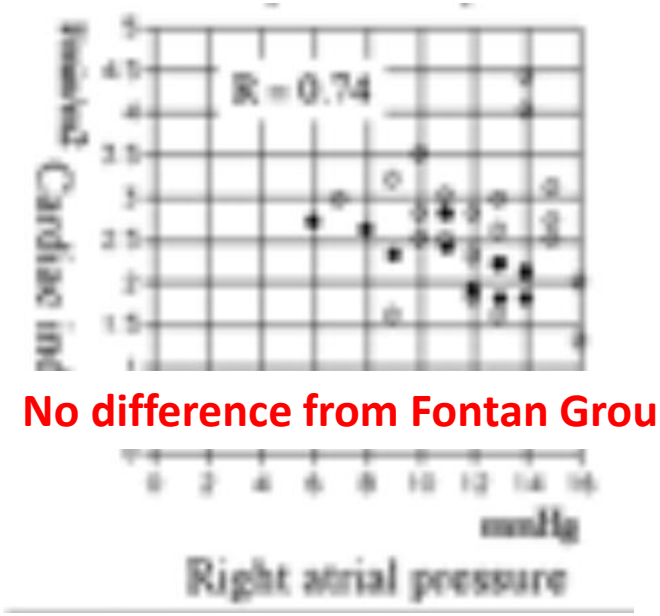
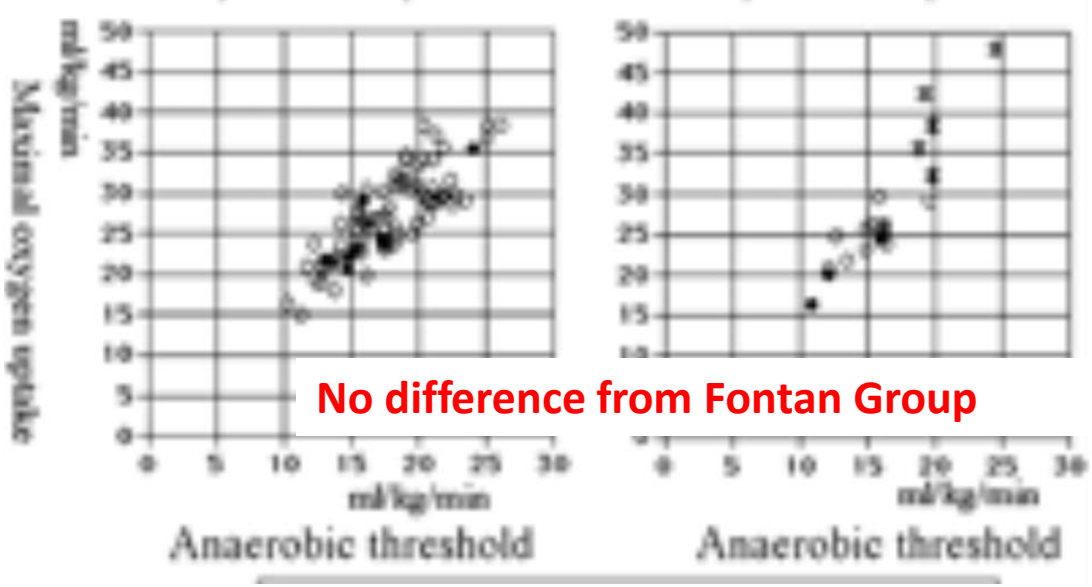
Functional Status: Exercise Testing in One-and-a-Half

Cardiac Index at 5 y
Fontan vs 1 ½



No difference from Fontan Group

Anaerobic Threshold at 5 y and 10 y
Fontan vs 1 ½



No difference from Fontan Group

Osaka, EJCTS 24:516, 2003

No attempt to differentiate different sub-types of 1 ½

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Functional Status: Exercise Testing in One-and-a-Half

Leiden:

Only two patients in 1 ½ group
VO_2 max 74% predicted
O_2 –pulse 56% predicted
Response to Dobutamine Stress: LV stroke volume does not change, exactly like Fontan

No difference from Fontan Group

JTCVS 143: 569, 2012

Buenos Aeres:

2 y post-op, VO_2 max.
PAIVS group achieved 68% predicted
Ebstein group achieved 78% predicted
Performance correlated with RV function

JTCVS 117: 662, 1999

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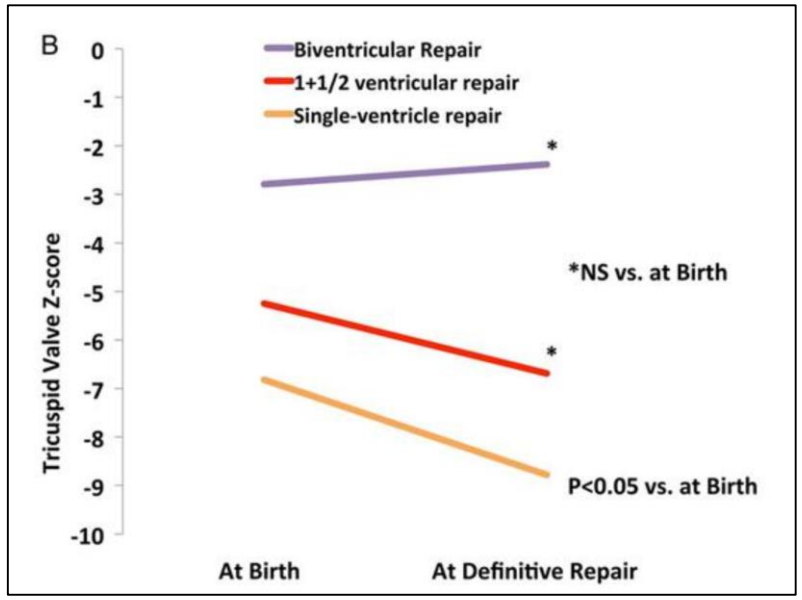
Is there Evidence that the RV can 'Grow' ?

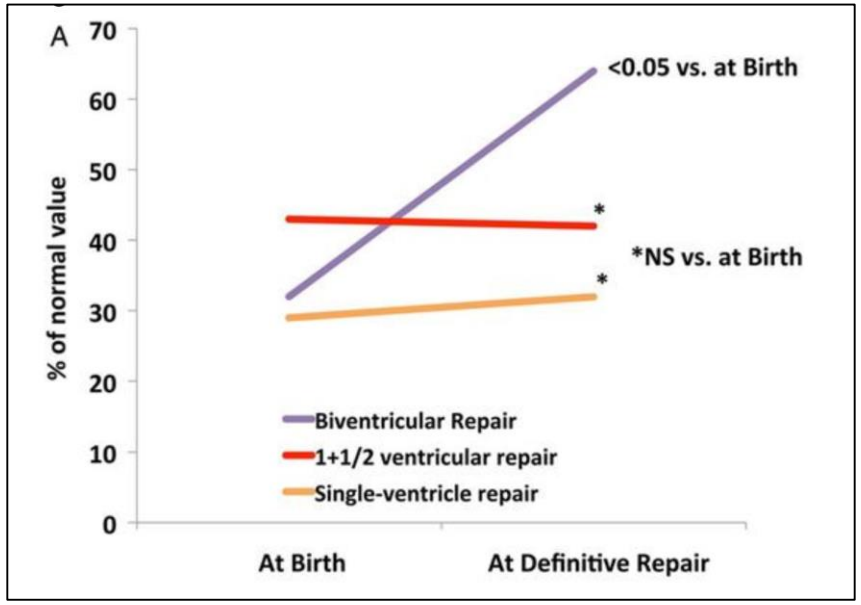
Is there an RV Equivalent to 'LV Rehabilitation'?

Sano: PAIVS n=50

TV z-score



RVEDV



TV z-score – no evidence of growth in any group
RVEDV only increases in the BVR group

EJCTS 50: 298, 2016

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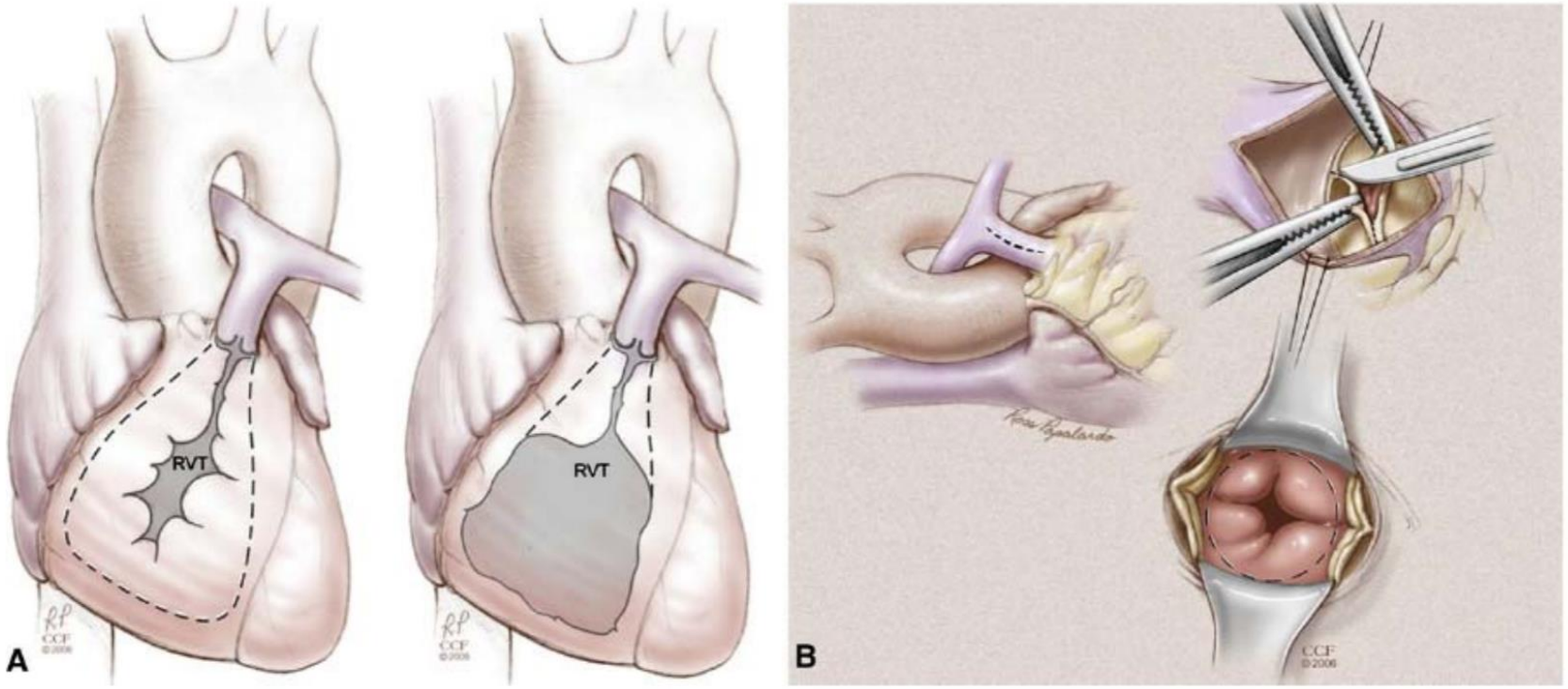
‘RV Overhaul’

Roger Mee: ‘RV Sinus Myectomy’



Intention was BVR rather than 1 ½

JTCVS 2008;136:735-42

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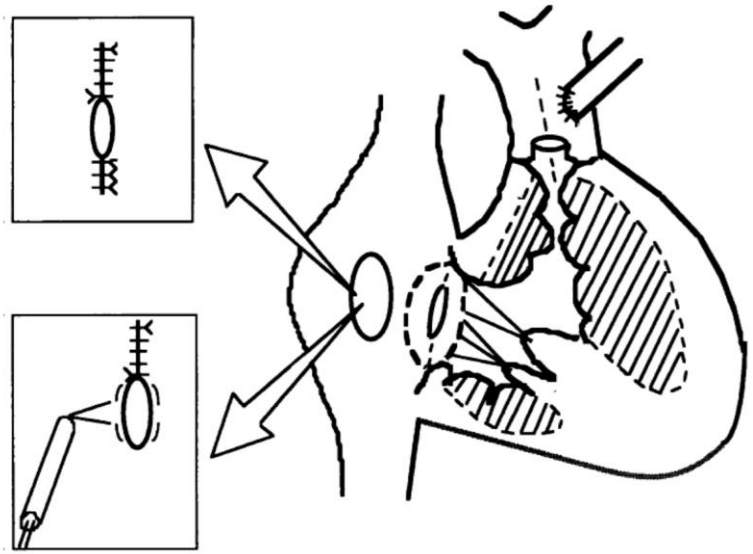
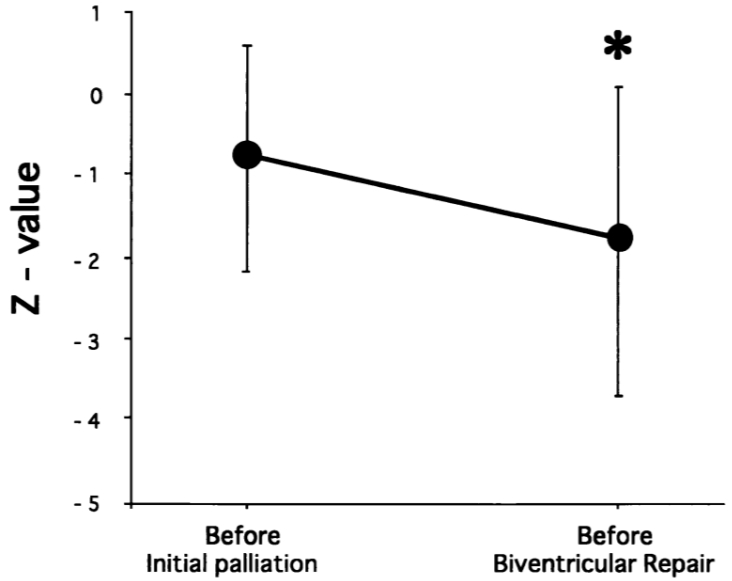
Use of Restrictive ASD

PAIVS All have initial Pulmonary vavotomy and BT Shunt
If RVEDV >50% predicted - attempt Overhaul



18/25 achieved BVR



Control ASD until RAP is < 15mmHg.

No patient with z-score < -2 achieved BVR

Ann Thorac Surg 2000:70:1501-6

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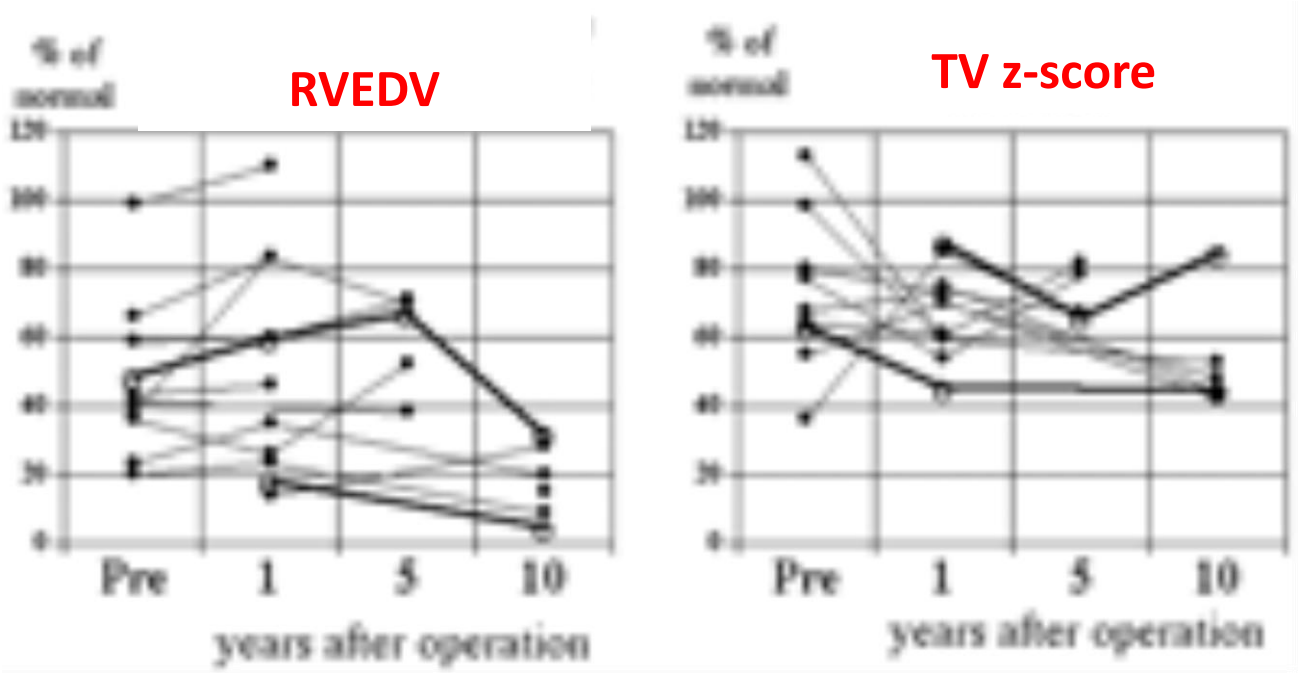
Evidence of RV Growth in One-and-a-Half?



Bold lines = patients converted to Fontan

EJCTS 24: 516, 2003

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Is One-and-a Half better than One?

Its all about patient selection

TV z-score -2 to -5 with good function……..YES (low IVC pressure but ↑ reinterventions)

But if RV too borderline or poor function...NO

No good evidence of RV growth – even with aggressive 'overhaul' policy

No good evidence that Exercise Function is superior to Fontan
But low IVC pressure may still be a valid benefit long-term

1 ½ for dilated and failing RV (eg Ebstein) has a role but is high risk

1 ½ to facilitate complex surgery or complex anatomy can be very useful

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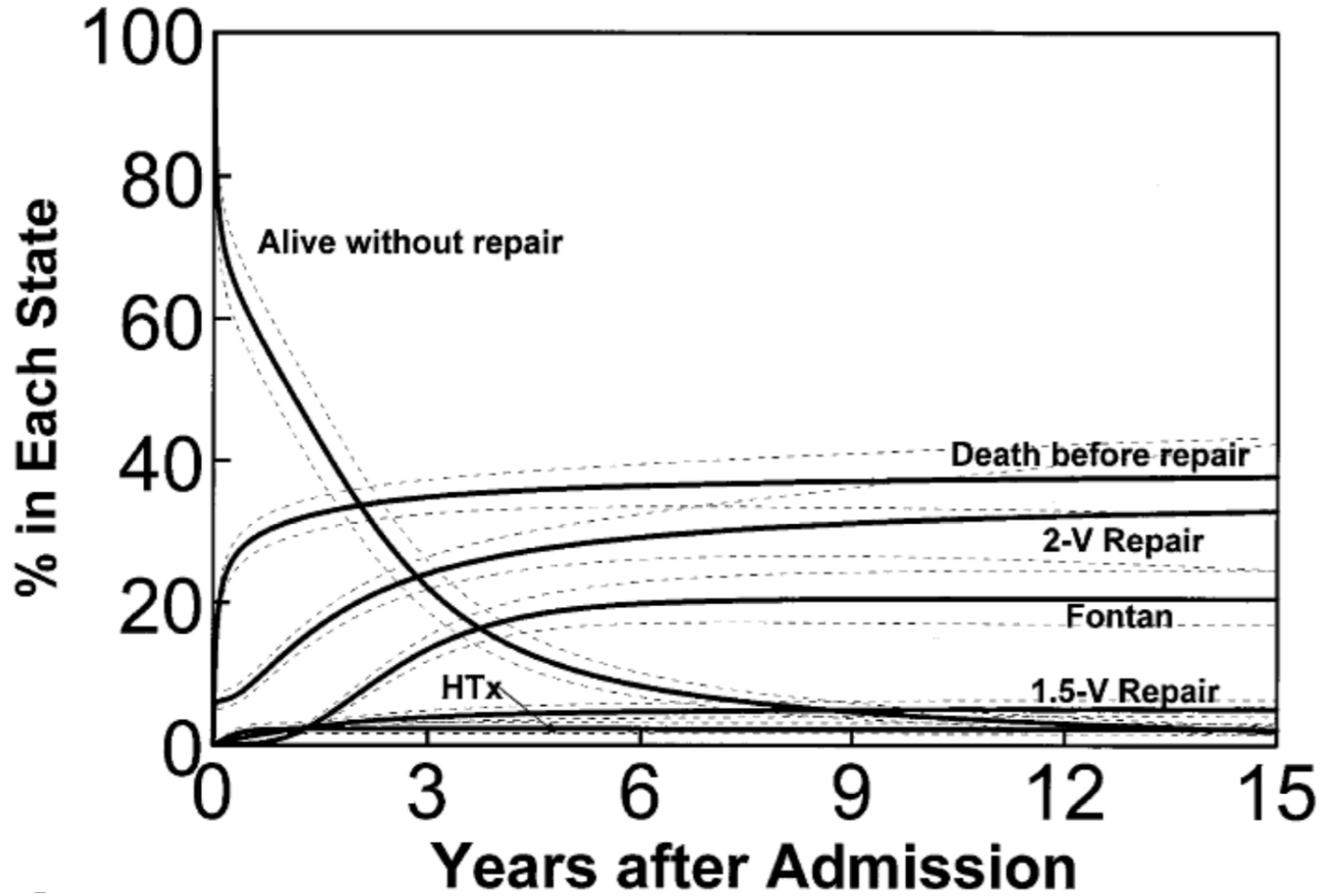

J Thorac Cardiovasc Surg 2004;127:1000-8 CHSS final outcome for n=408 neonates…..shows that the I ½ is rarely used

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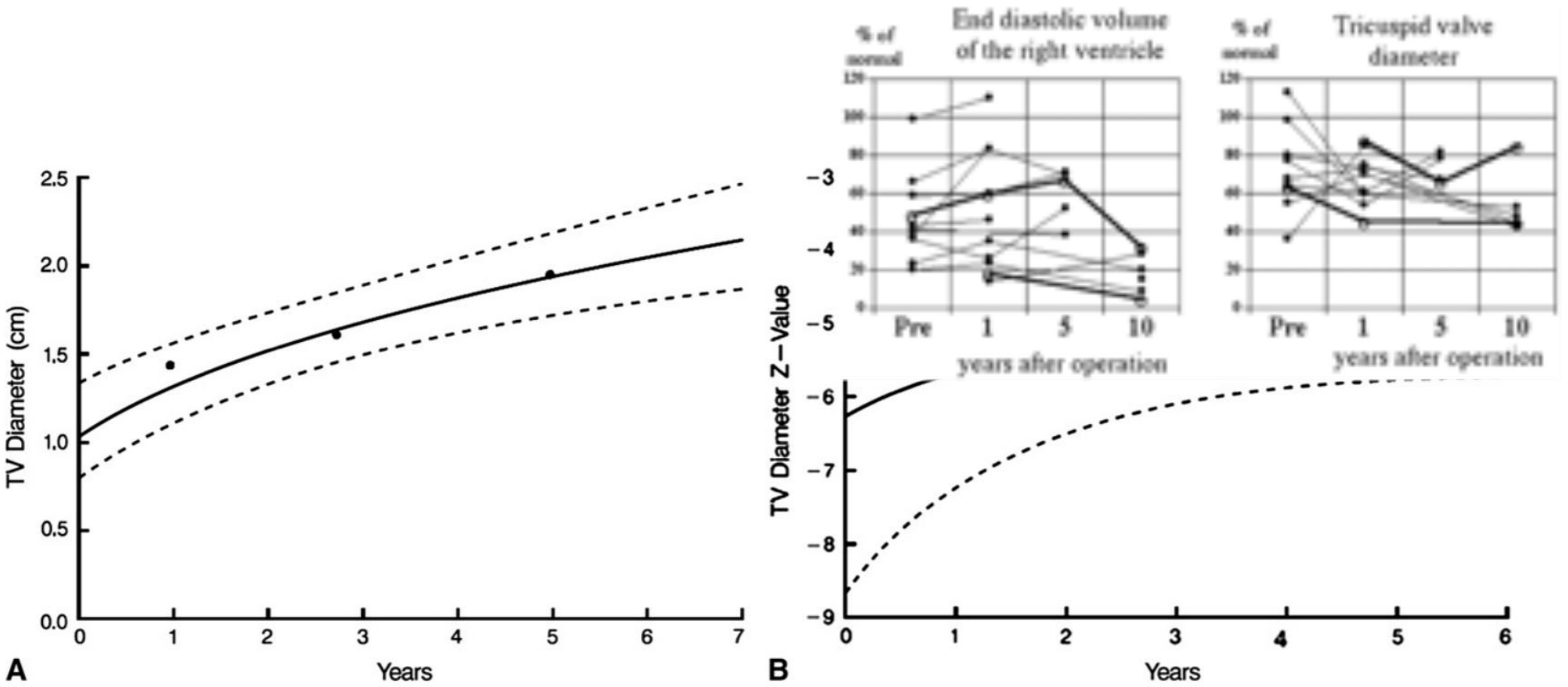

Roger Mee….shows that z score even in BVR after Overhaul does not change ….. Though he is the only paper that has achieved BVR in such small z-scores. JTCVS 136:735, 2008

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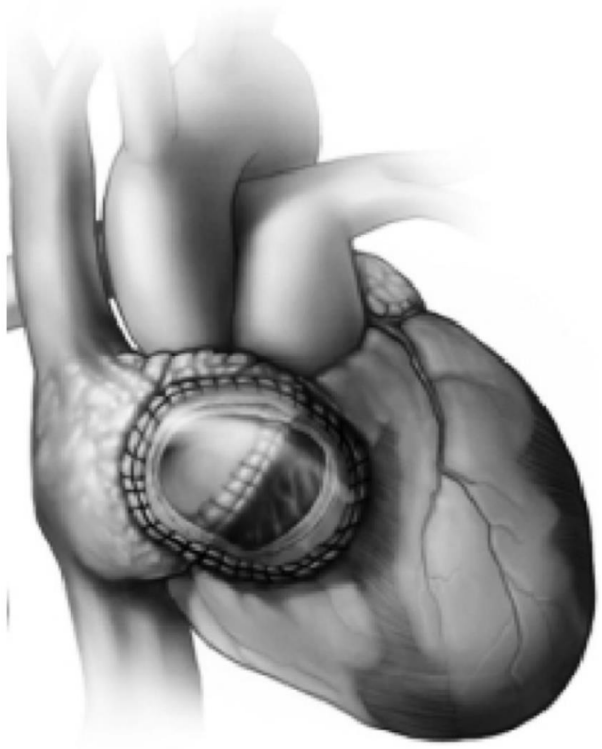

Mayo paper…..conversions of Bjork type APC

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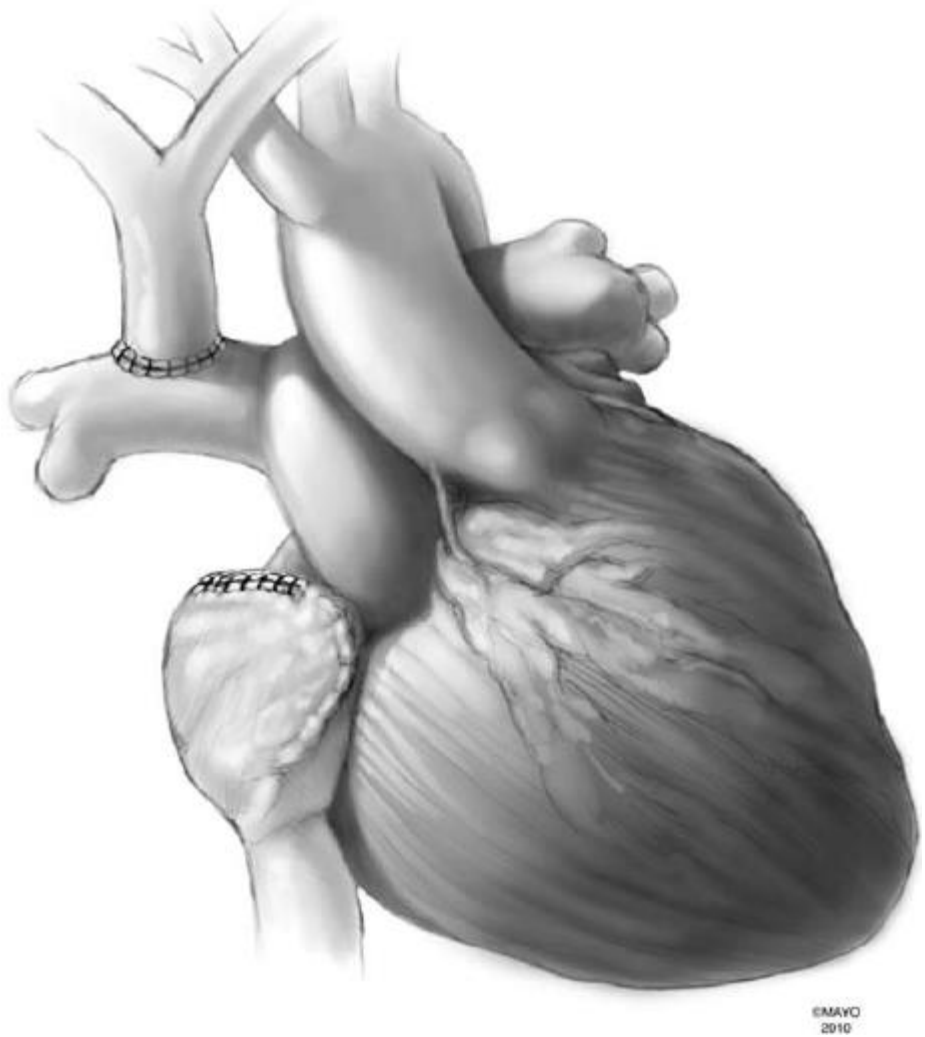

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