Pulmonary Regurgitation after TOF Repair.

How to Assess and Options of Management?

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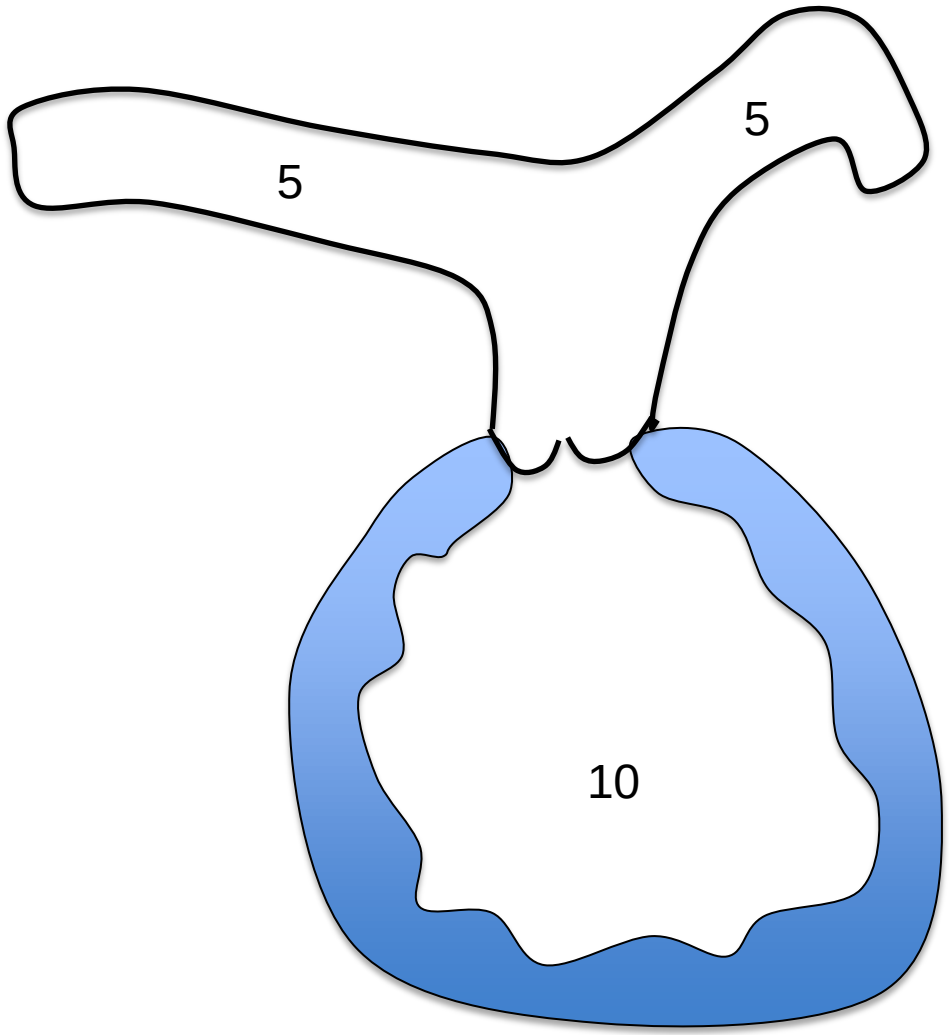
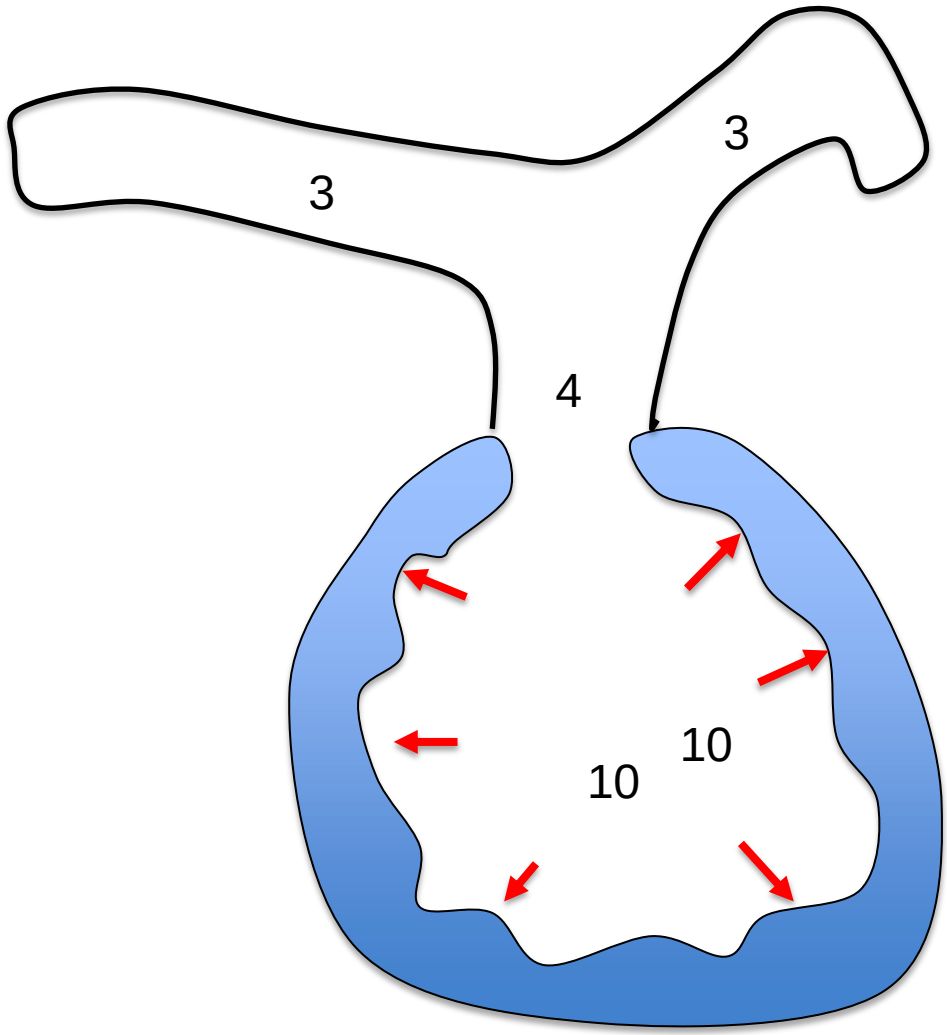
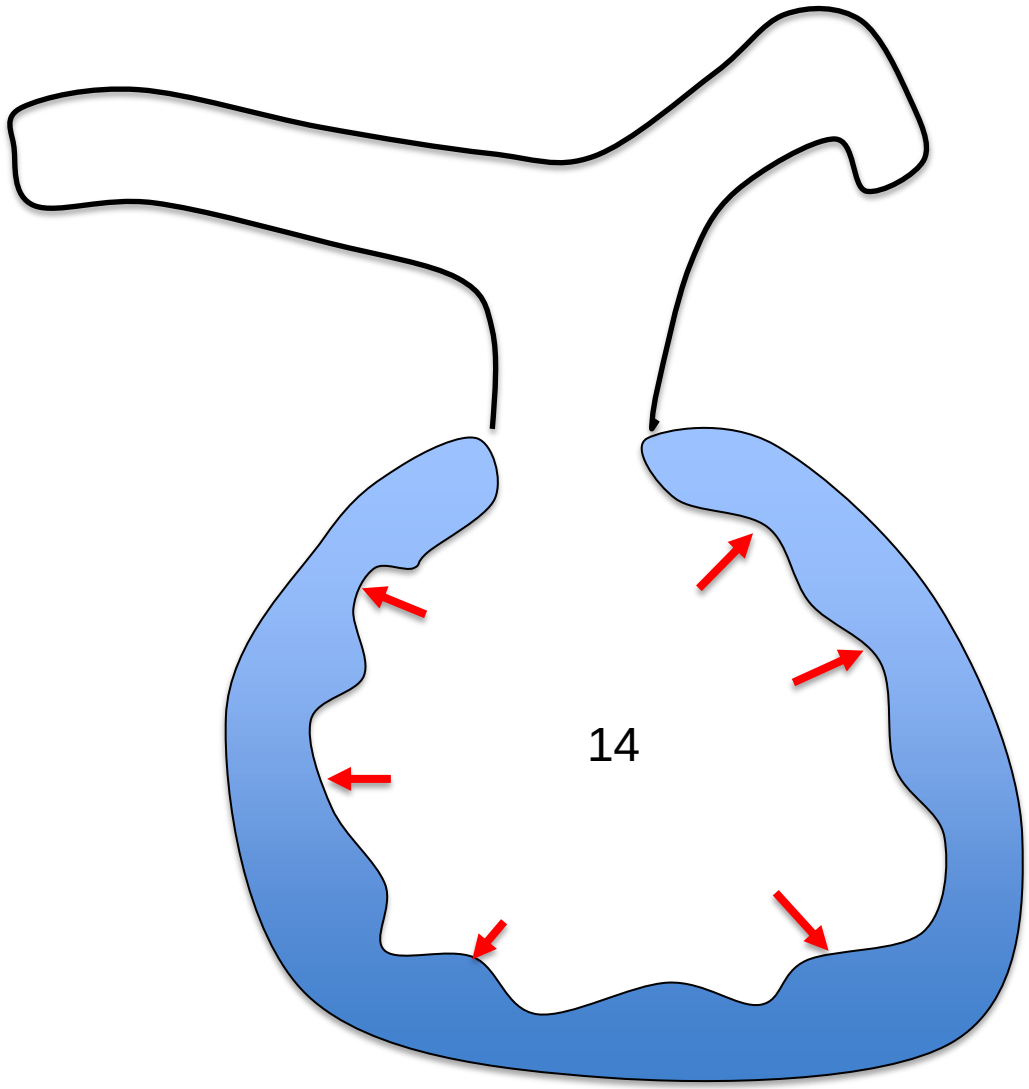
How to Assess?



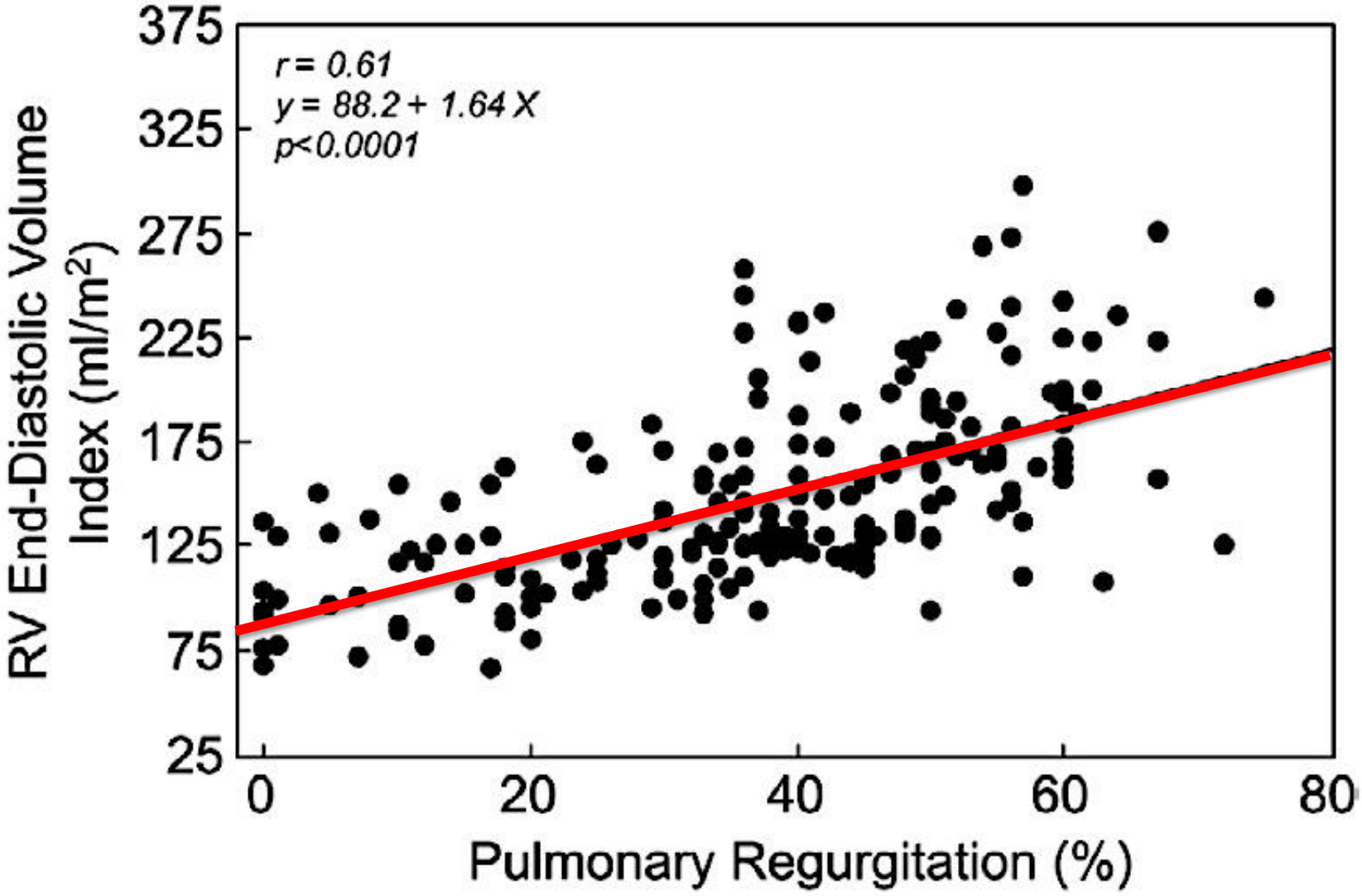
Competent pulmonary valve



SEVERE Incompetent pulmonary valve

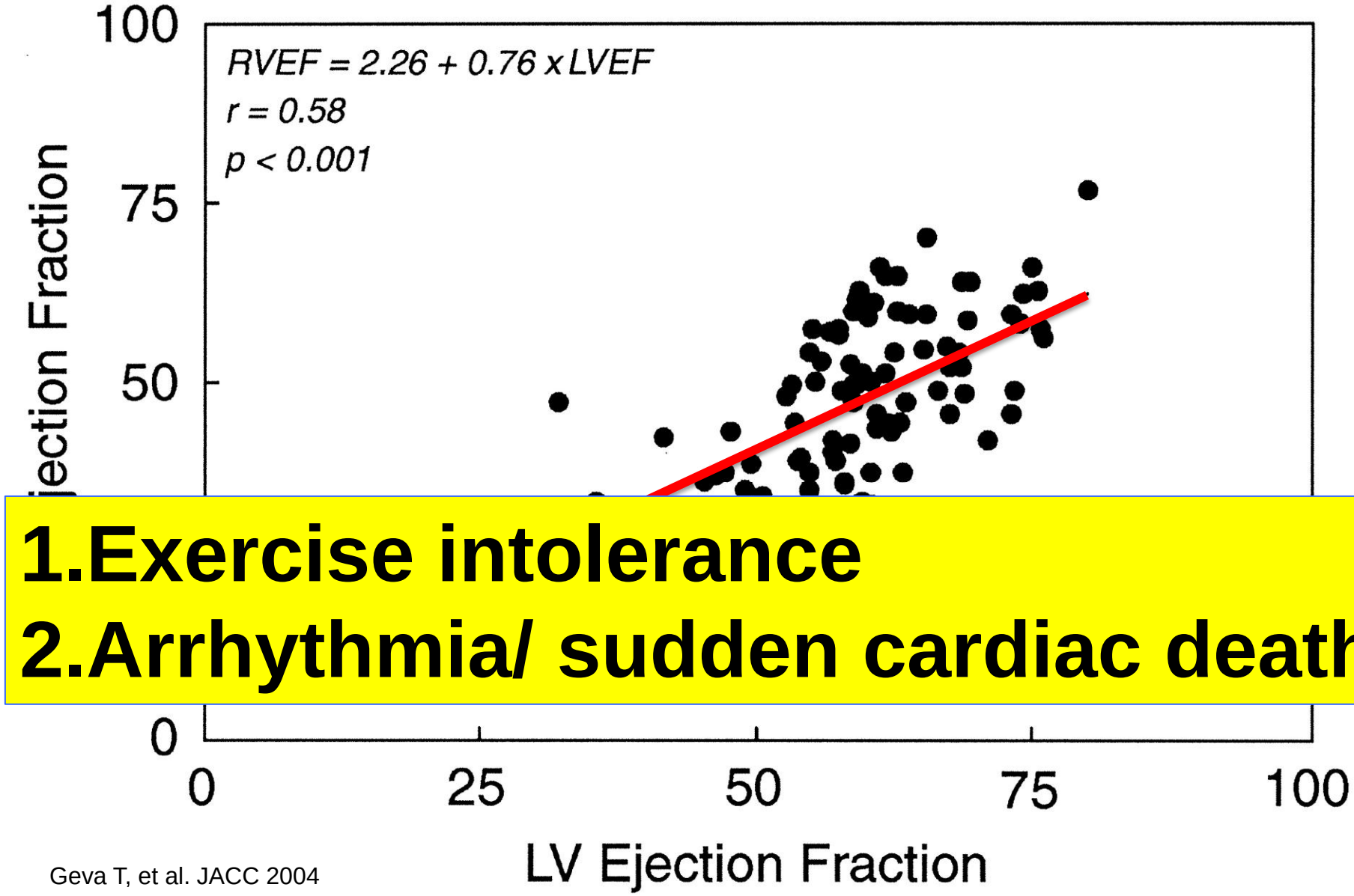


SEVERE Incompetent pulmonary valve



Incompetent pulmonary valve

Geva T. Semin Thorac Cardiovasc Surg Pediatr Card Surg Ann 2006.



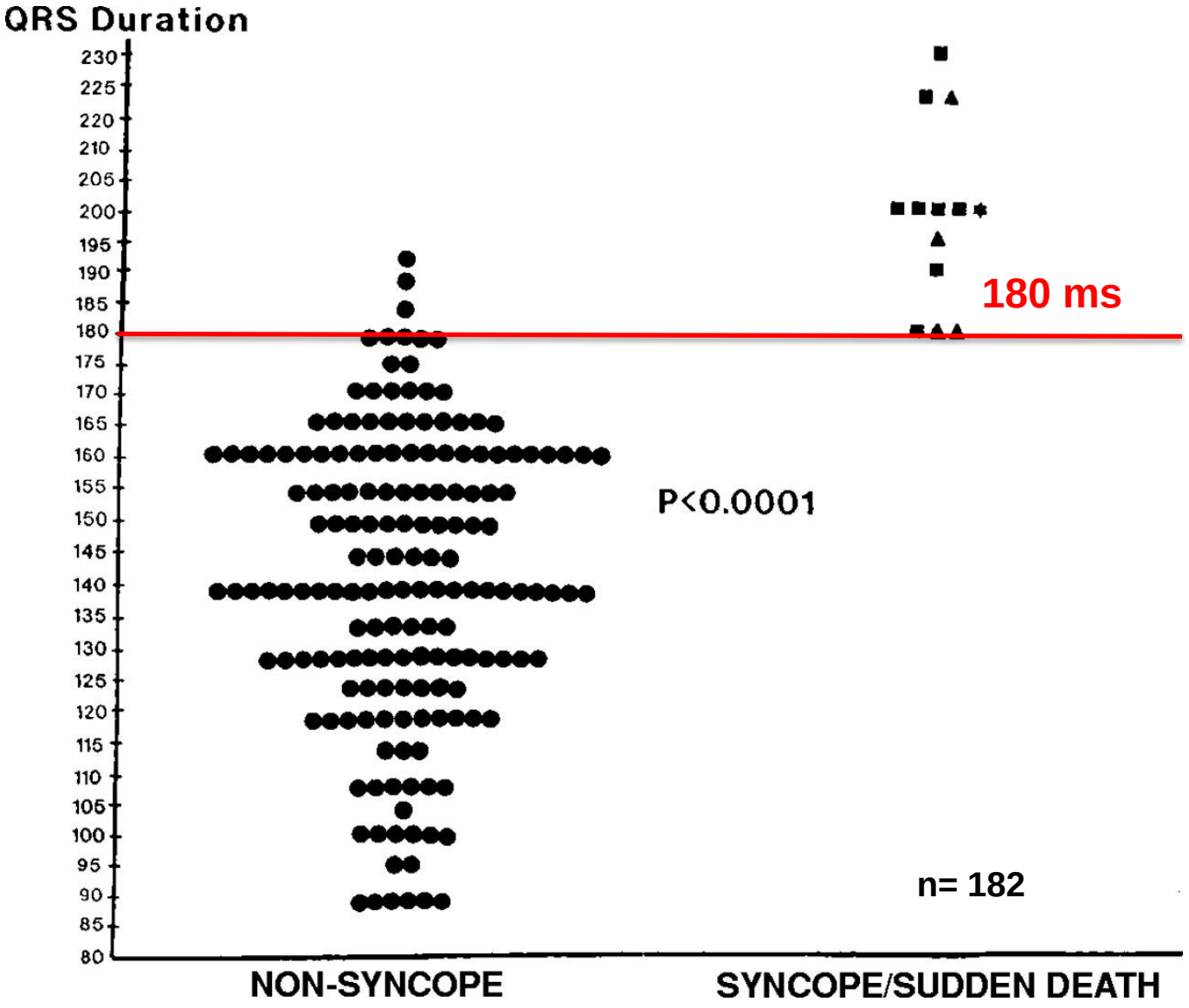
1.Exercise intolerance

2.Arrhythmia/ sudden cardiac death

Geva T, et al. JACC 2004

RV & LV interaction in Post TOF repair with severe

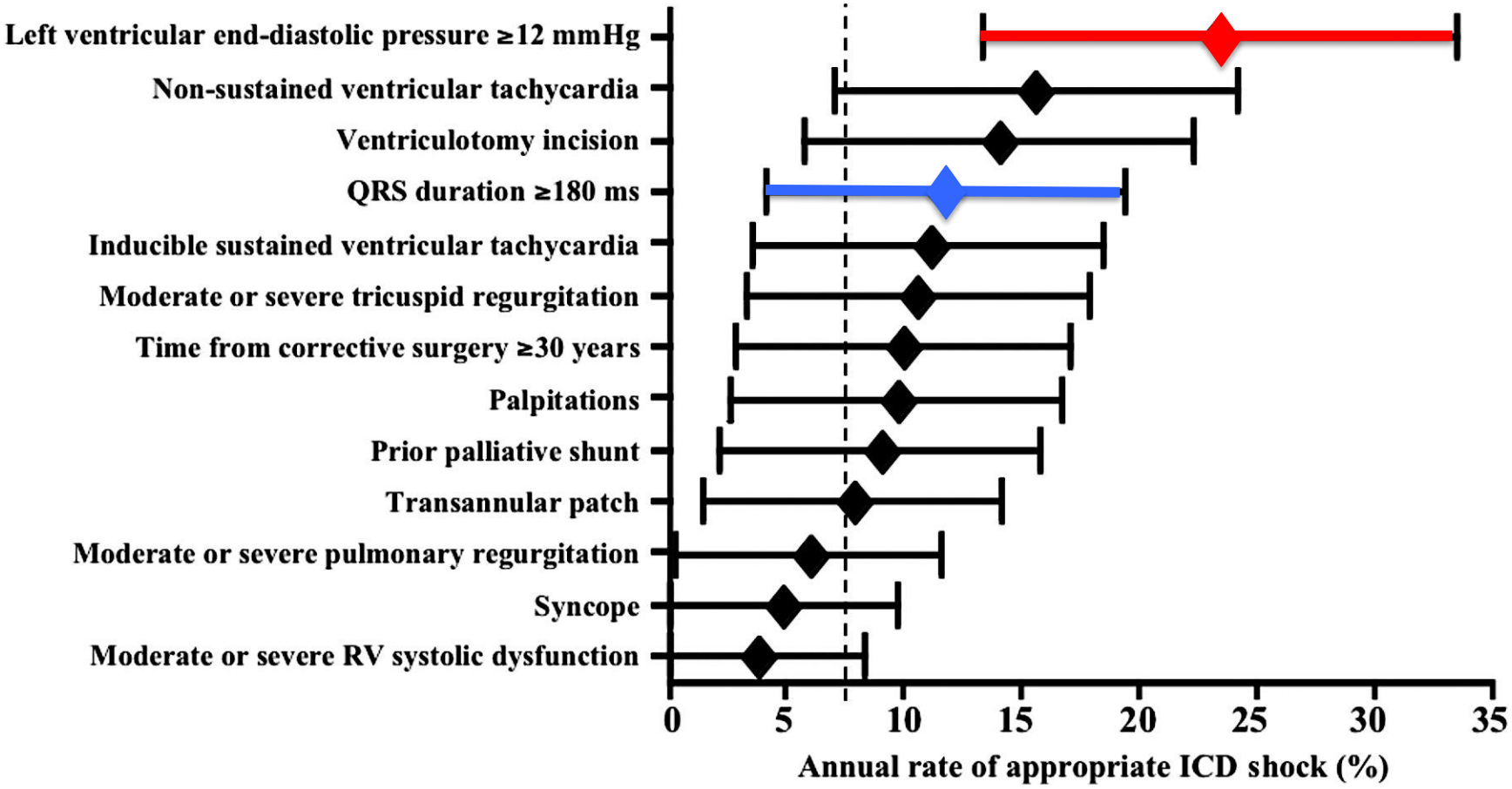
QRS duration and outcomes



Gatzoulis M et al. Circulation 1995;92:231-237

Implantable Cardioverter-Defibrillators in Tetralogy of Fallot

Paul Khairy, MD, PhD; Louise Harris, MD; Michael J. Landzberg, MD; Sangeetha Viswanathan, MRCPCH; Amanda Barlow, MD; Michael A. Gatzoulis, MD; Susan M. Fernandes, MHP, PA-C; Luc Beauchesne, MD; Judith Therrien, MD; Philippe Chetaille, MD; Elaine Gordon, MD; Isabelle Vonder Muhll, MD; Frank Cecchin, MD



Circulation. 2008;117:363-370

Predictors of Sudden Cardiac Death

History	Electrophysiologic	Hemodynamic
Syncope Later age at repair Associated morbidity Activity level	QRS Duration Incidence of SVT Sustained SVT	Enlargement of RV Severity of PR Severity of TR RV & LV function LVEDP

Khairy et al. Value of programmed ventricular stimulation after tetralogy of Fallot repair: A multicenter study. Circulation 2004:109;1994-2000.
Gatzoulis et al. Risk factors for arrythmia and sudden cardiac death late after repair of tetralogy of Fallot: a multicentre study. Lancet 2000;356:975-81.

Indications for Pulmonary Valve Replacement

Symptoms		
Exercise intolerance Syncope		
Anticipation of symptoms: Planning for pregnancy		

Non invasive RV assessment

- **Echo as a screener**
- **CMR as a reference**

Echo

1. Volume
2. Function
    1. TAPSE
    2. FAC
    3. TDI
    4. Strain and strain rate

CMR

1. RV volumes
2. RV flow, PA flow, PV flow
3. Delayed enhancement

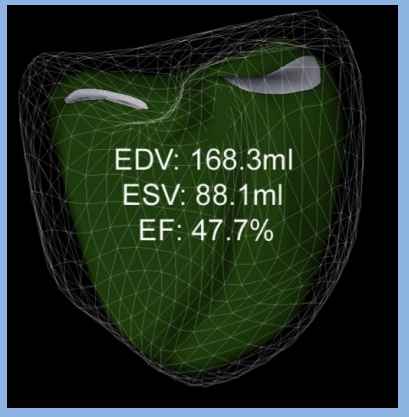
Echocardiogram

2D-measurements for RV volume

- **Lack of normative data for the different measurements.**
- **Poorly correlate with MRI measurements***
- **Interobserver variability is relatively high****

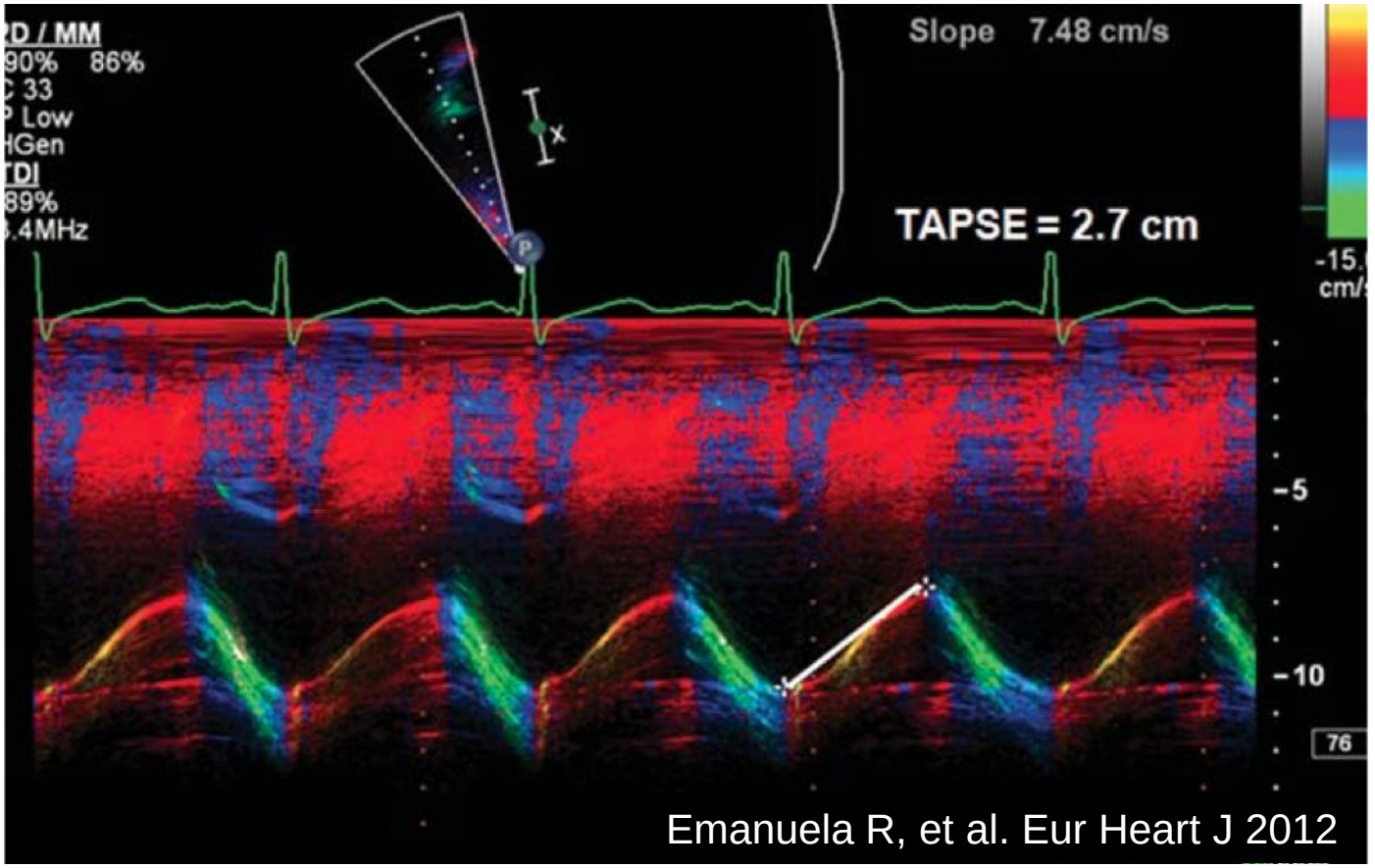
* Lai et al. Int J CV Imaging 2008
** Greutmann JASE 2010

Moving towards 3D-volumatrics method



Echocardiogram

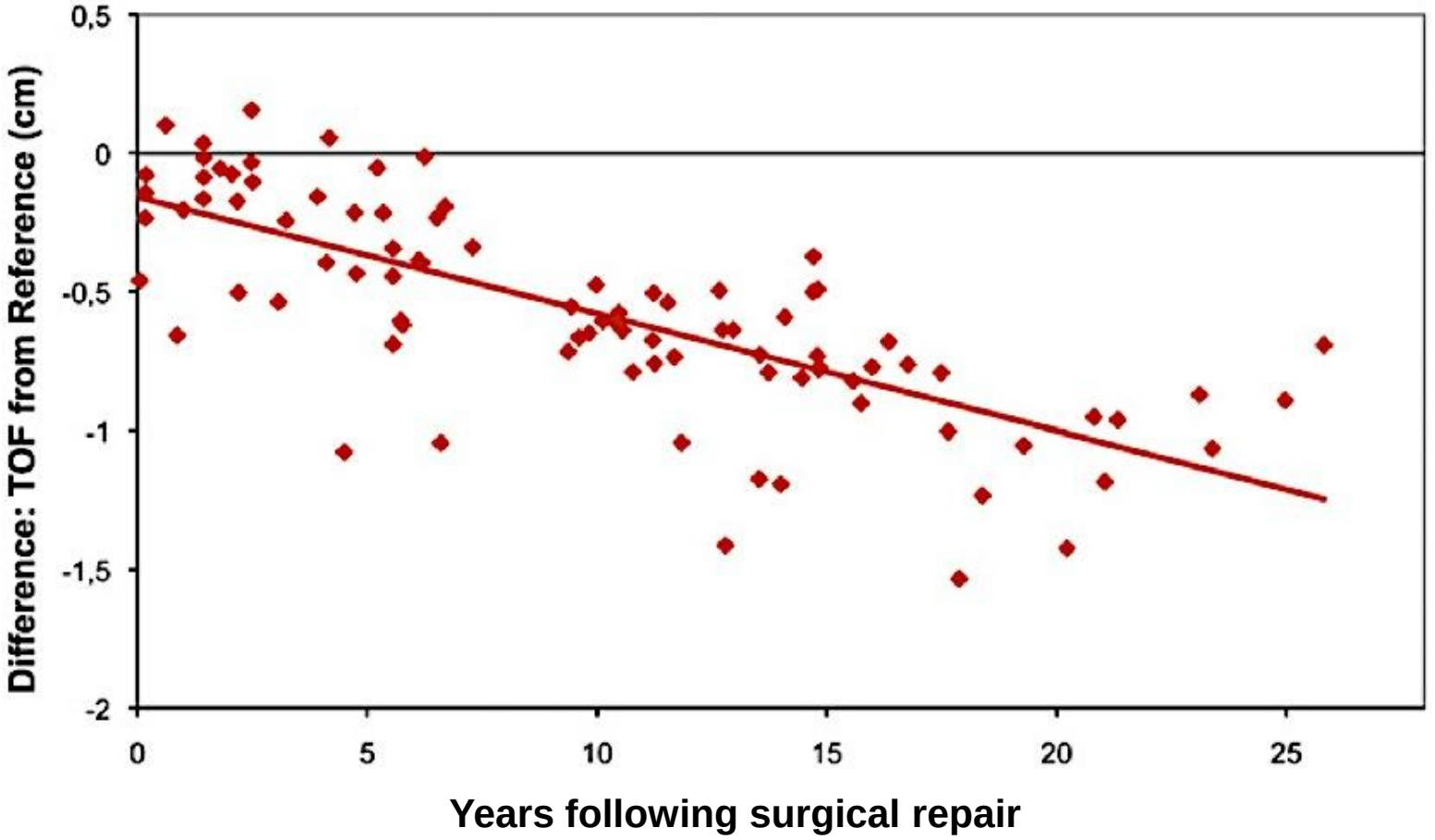
Assessment of RV function



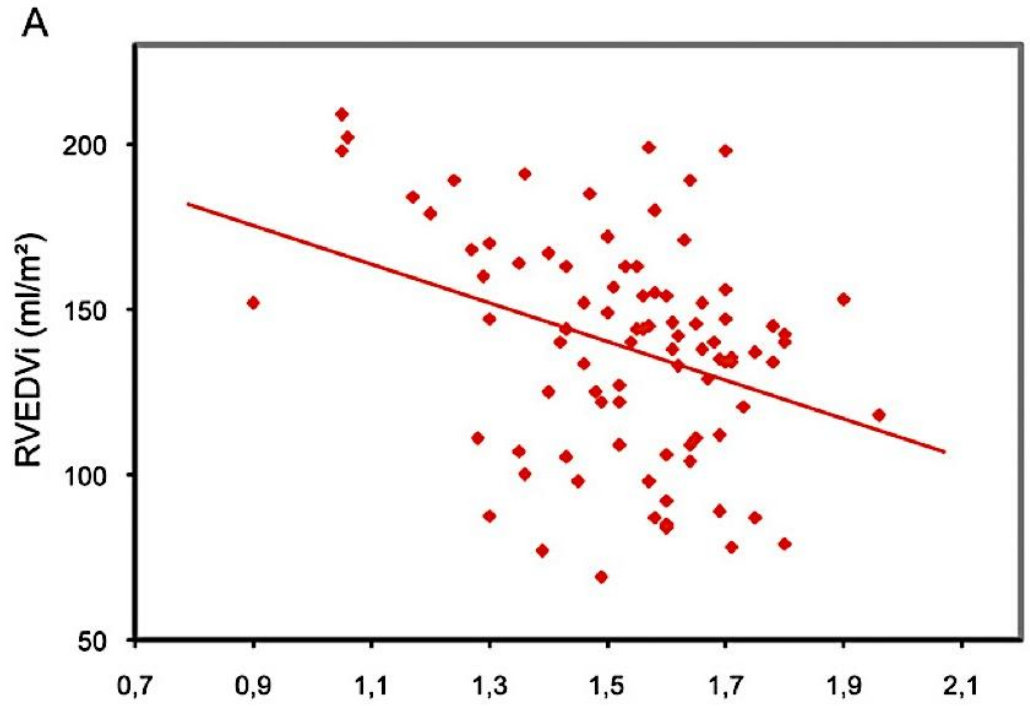
Tricuspid annular plane systolic excursion (TAPSE)

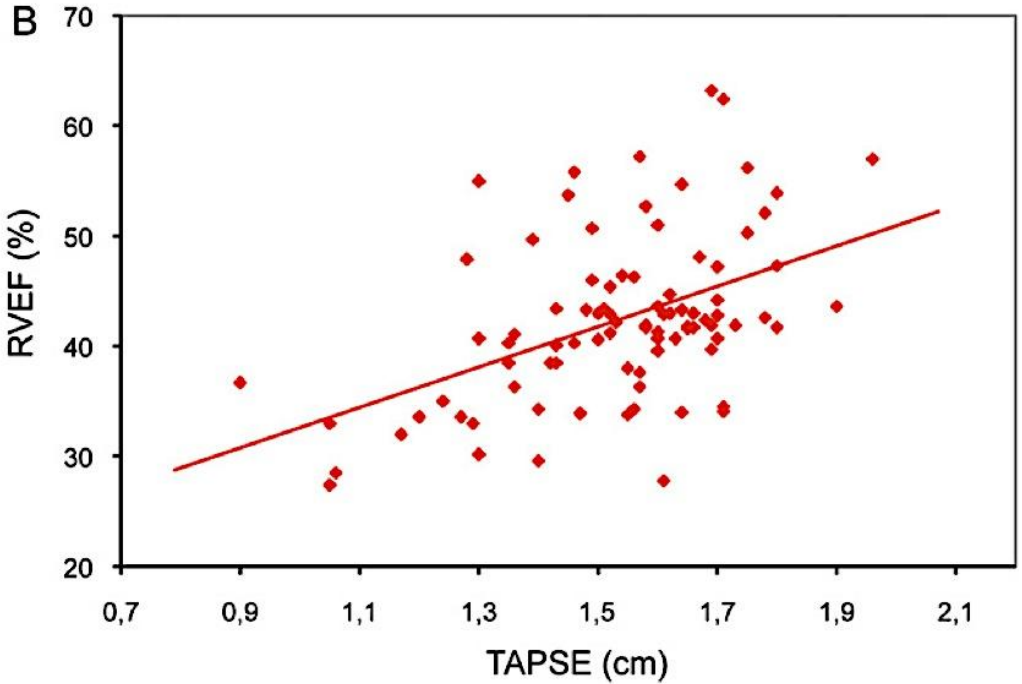
Normal value > 16 mm

TAPSE decreased after TOF repair



Koestenberger JASE 2011



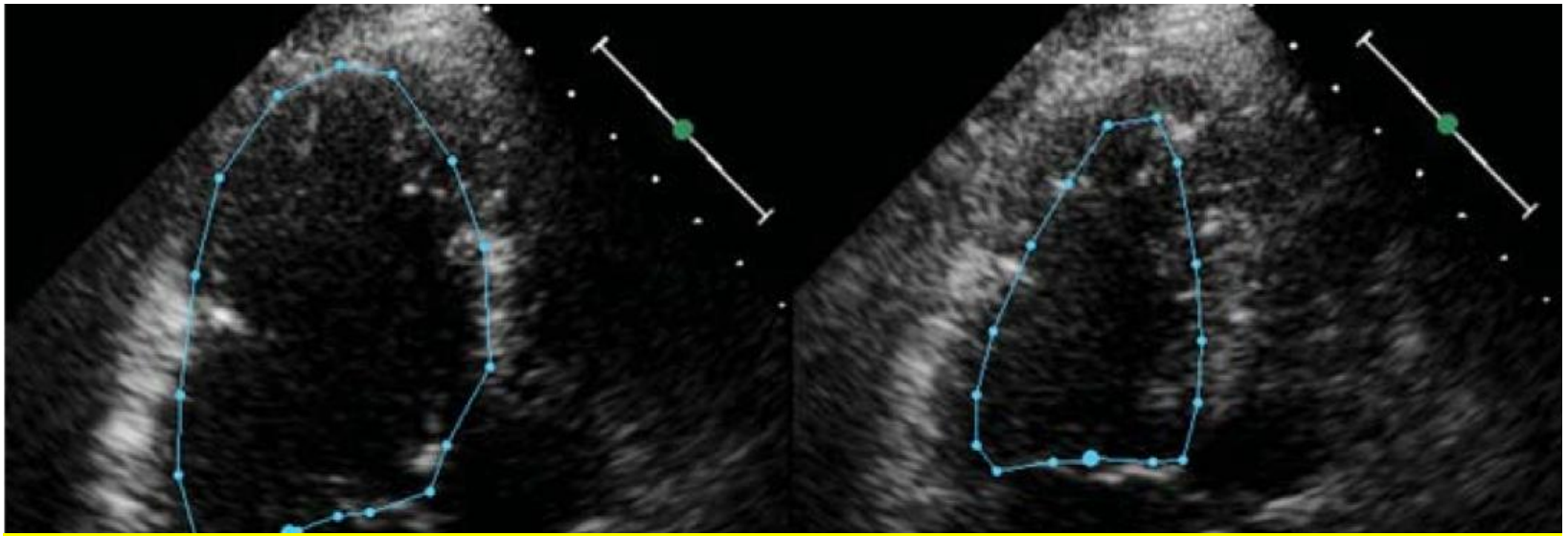


Poor correlation between TAPSE- RVEDVi and TAPSE-RVEF in TOF *

***Koestenberger JASE 2011**

Echocardiogram

Assessment of RV function



Reasonably correlated with MRI RVEF*

*Anavekar, EchocardIography 2007

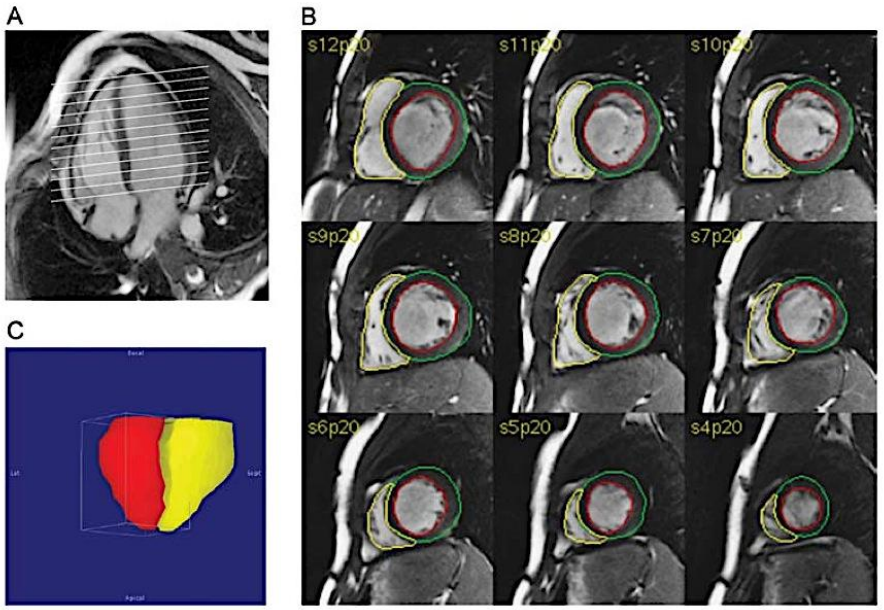
Fractional area change (FAC) (EDA-ESA)/EDA

Normal value > 35%

Cardiac MRI

Assess function

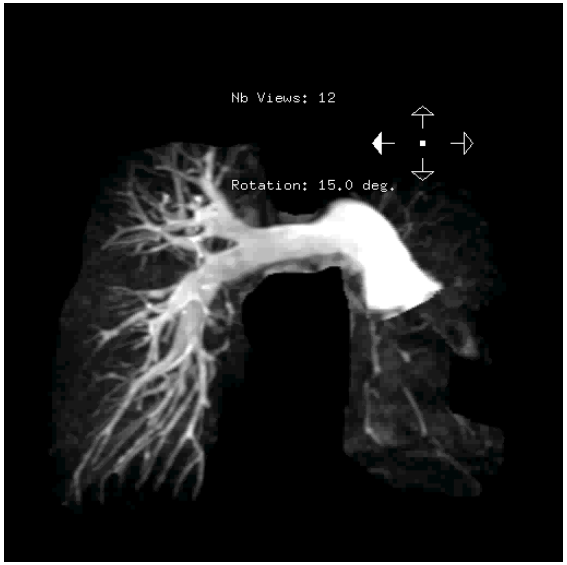
- PR RF
- RVEDV(i), LVEDV(i)
- RVEF, LVEF, etc.



Emanuela R, et al. Eur Heart J 2012

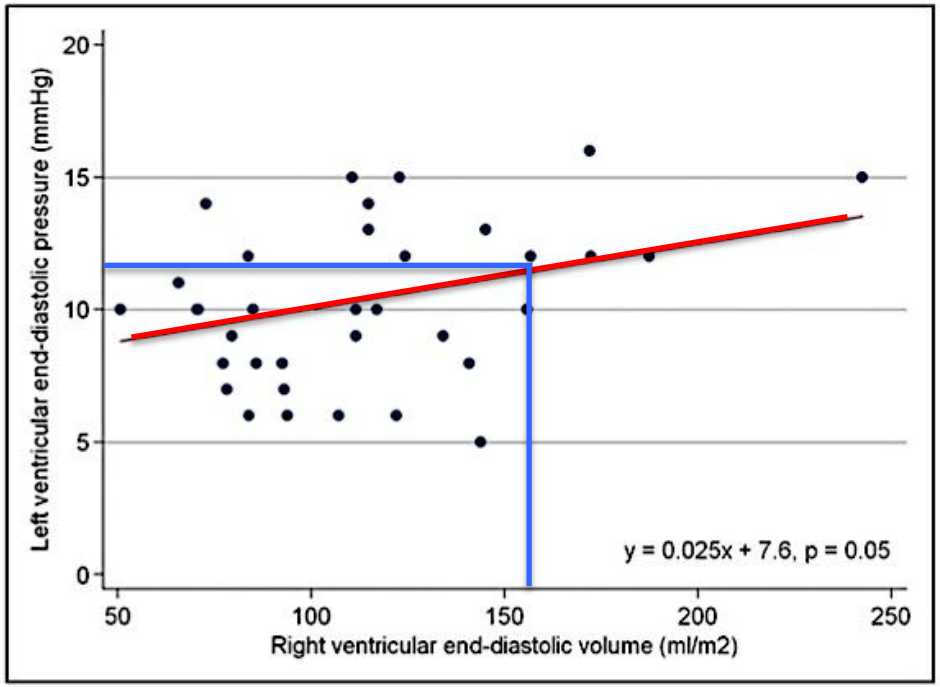
Assess anatomy

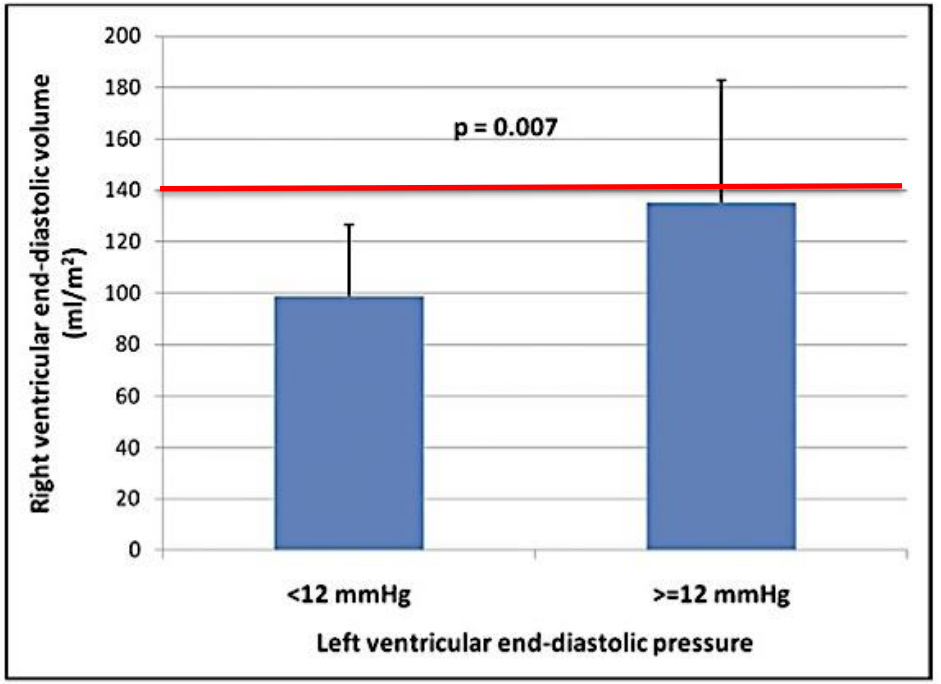
- RVOT aneurysm
- Branch PA stenosis
- Residual shunt, etc.



Relation of Left Ventricular End Diastolic Pressure to Right Ventricular End Diastolic Volume After Operative Treatment of Tetralogy of Fallot

Matthew C. Schwartz, MD*, Jonathan J. Rome, MD, Matthew J. Gillespie, MD,
Kevin Whitehead, MD, Matthew A. Harris, MD, Mark A. Fogel, MD, and Andrew C. Glatz, MD

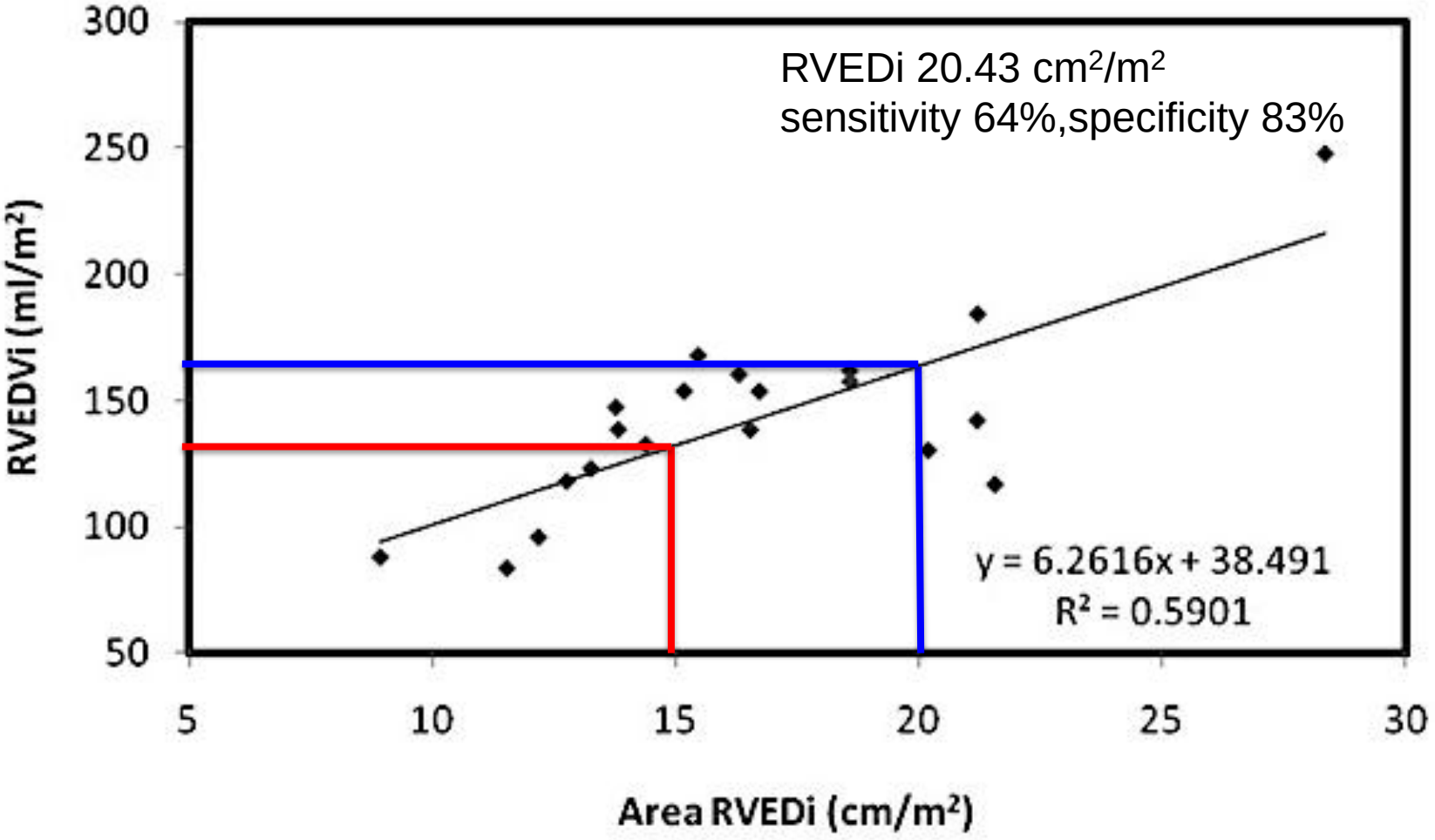




RVEDVi < 140 ml/m2 is (perhaps) what we aim for treatment

Am J Cardiol 2012;109(3):417-22

RVEDVi (CMR) vs. Area RVEDi (Echo)

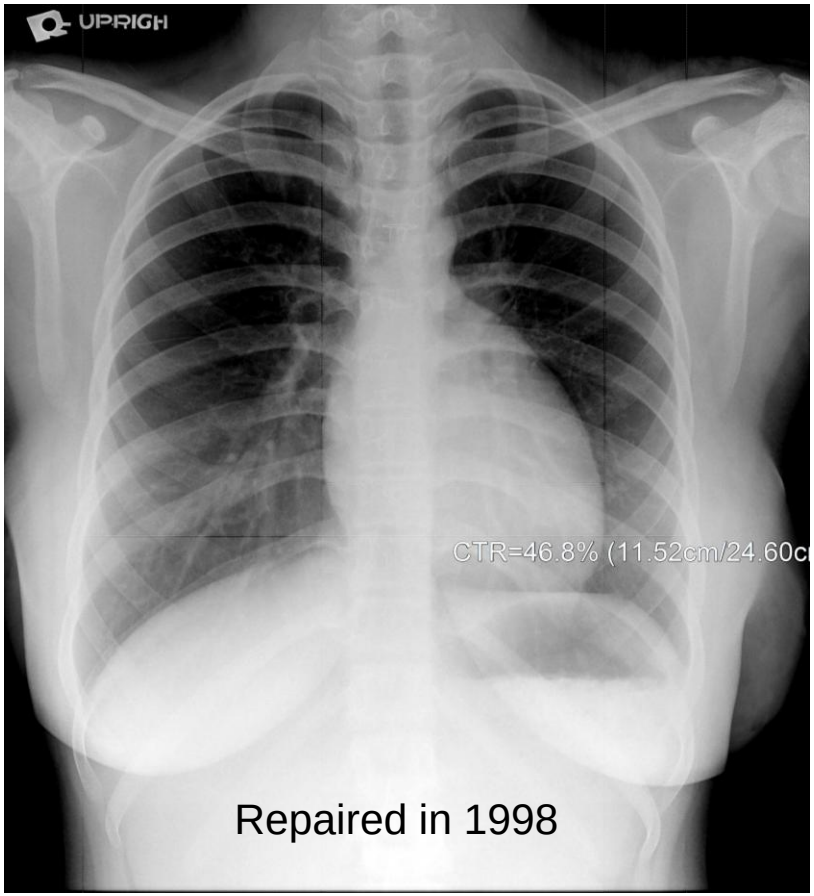


Katanyoowong P, et al. WPCCS 2013

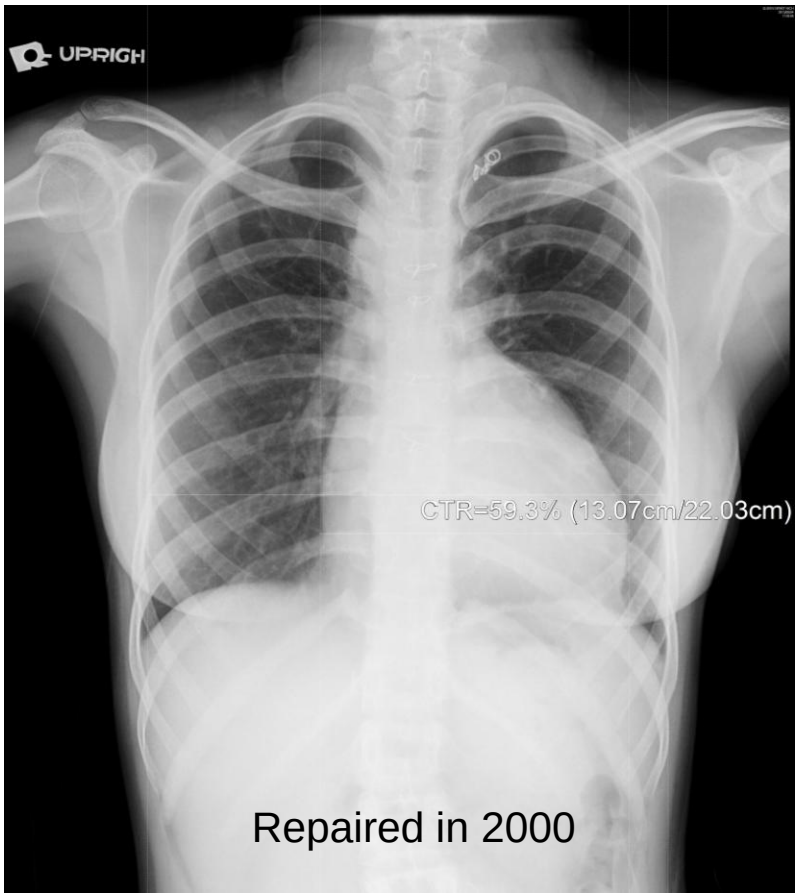
Everything is straight forward?

Not really!

Not all patients behave the same!

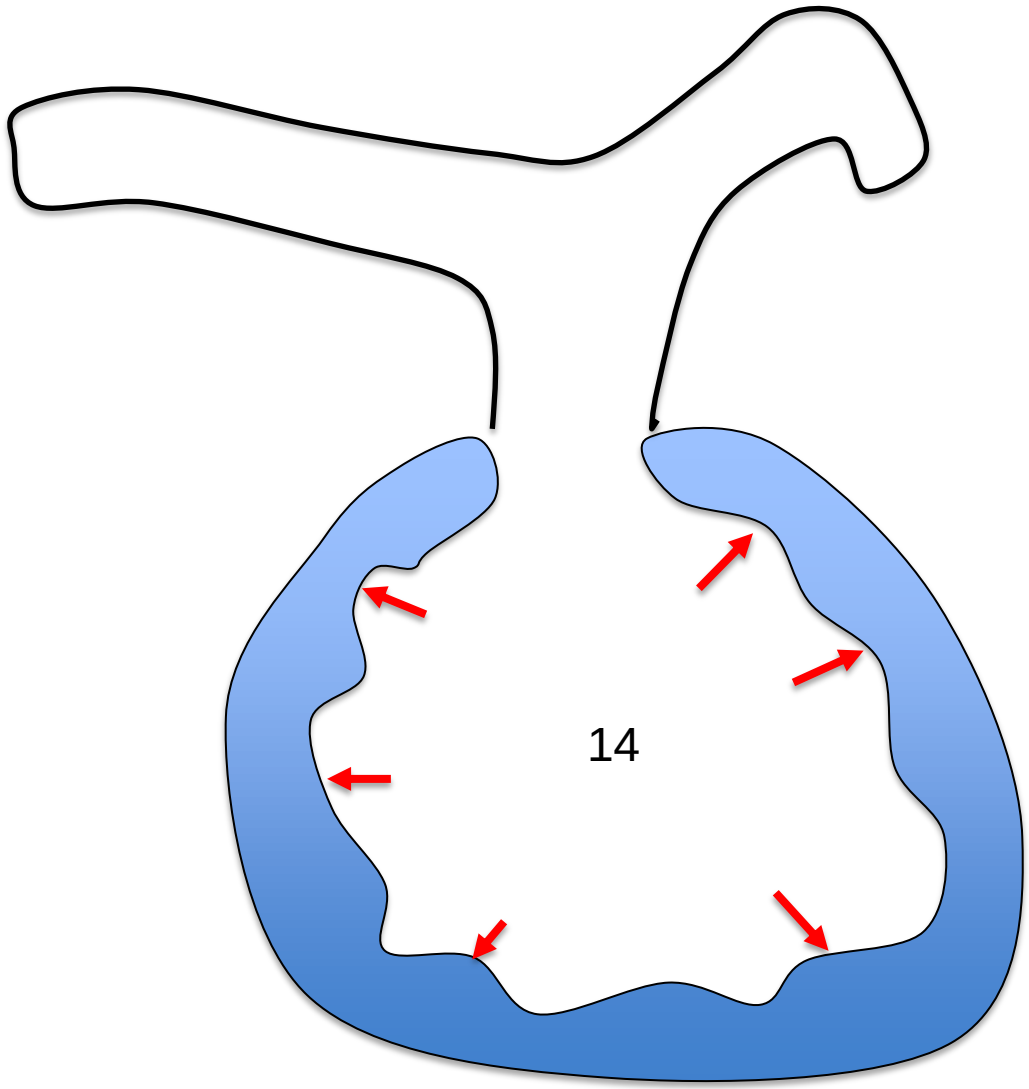


Repaired in 1998



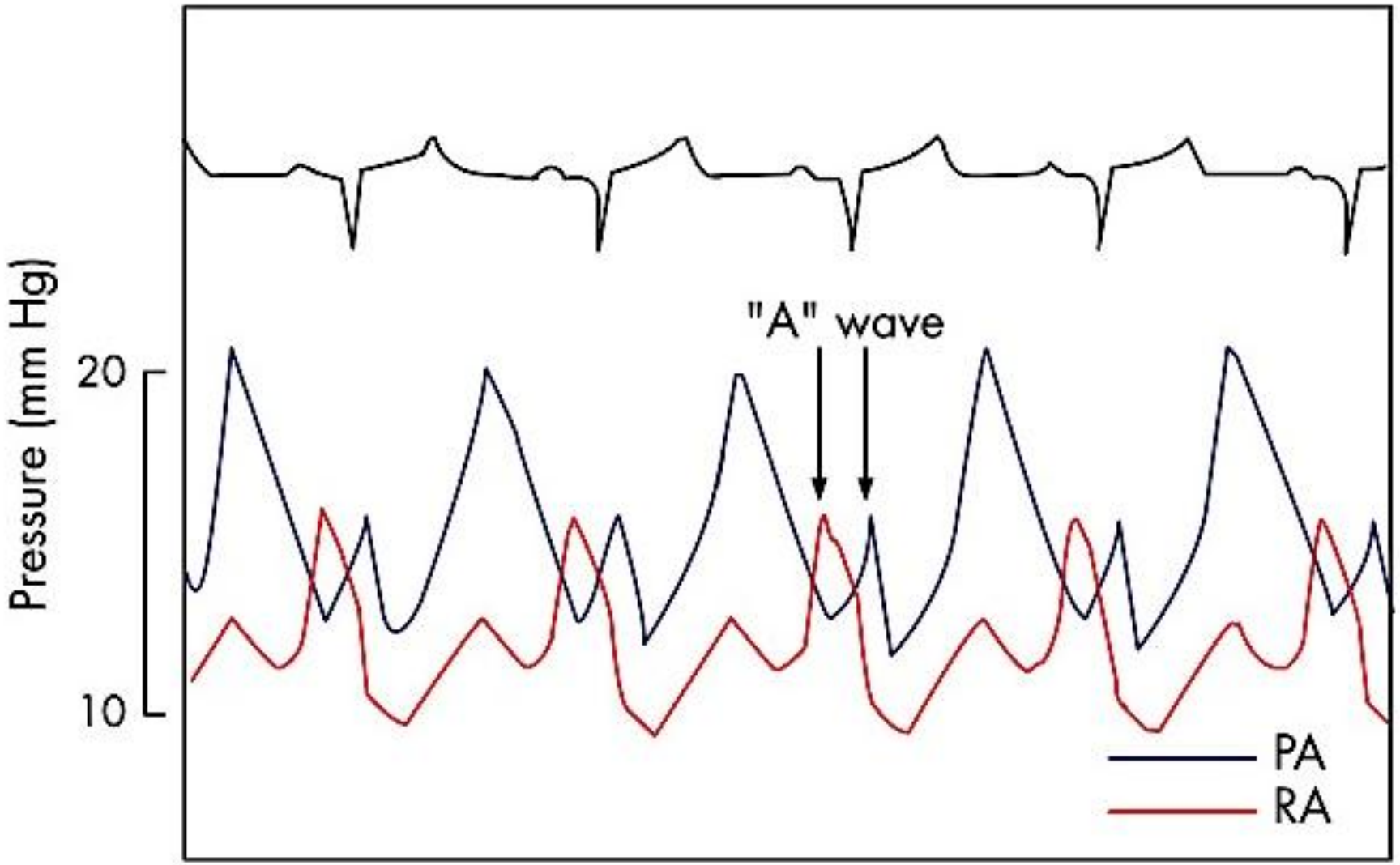
Repaired in 2000

Both having severe PR



Incompetent pulmonary valve

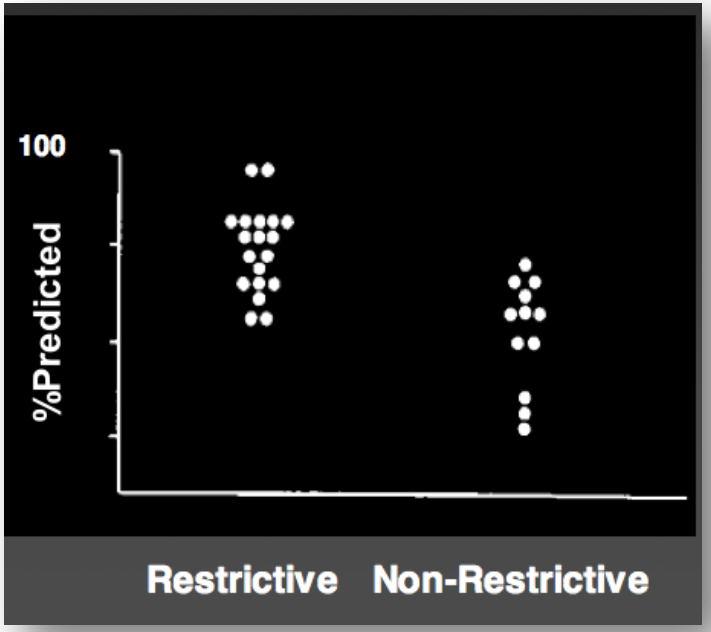
Incompetent pulmonary valve with RESTRICTIVE RV



Chaturvedi RR, Redington A. Heart 2007;93;880-889

Restrictive physiology predicted

Smaller heart on CXR
Smaller RV
Better exercise tolerance
Shorter QRS duration



Gatzoulis et al. Circulation 1995;92:231-7.

How to Assess PR after TOF repair **?**

- **Clinical**
  - symptoms: syncope, exercise intolerance
- **CXR**
  - heart size
- **Echocardiogram**
  - FAC, RVEDAi, LVEF and other.
- **CMR**
  - RVEDVi and other.

Indications for PVR (MY PRACTICE!)

Symptoms	Asymptomatic	Incidental
Exercise intolerance Syncope Anticipation of symptoms: Planning for pregnancy		PS, RVOTO Residual VSD RVOT/PA aneurysm Severe TR AR

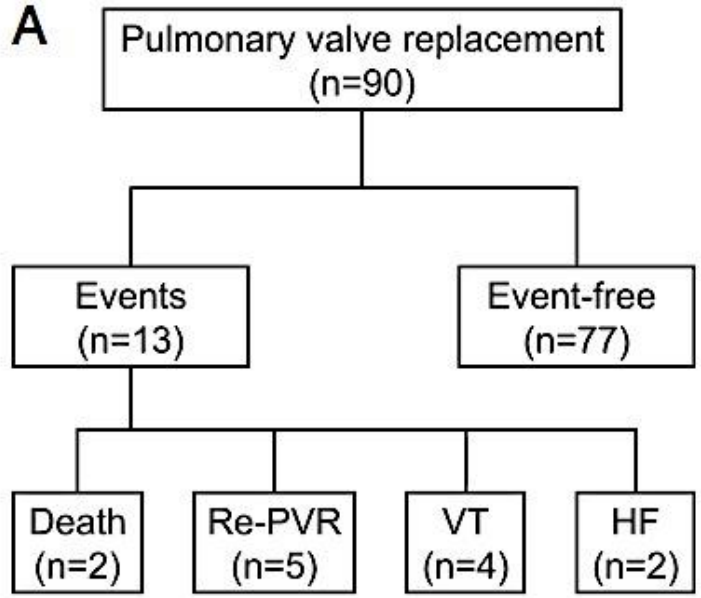
Options of Management?

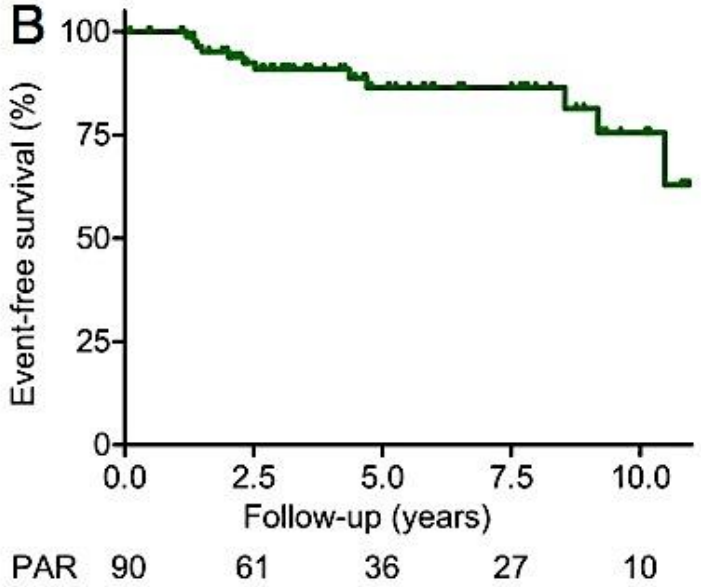
- **“Scalpel” is a gold standard.**
- **“Catheter” is an emerging modality.**

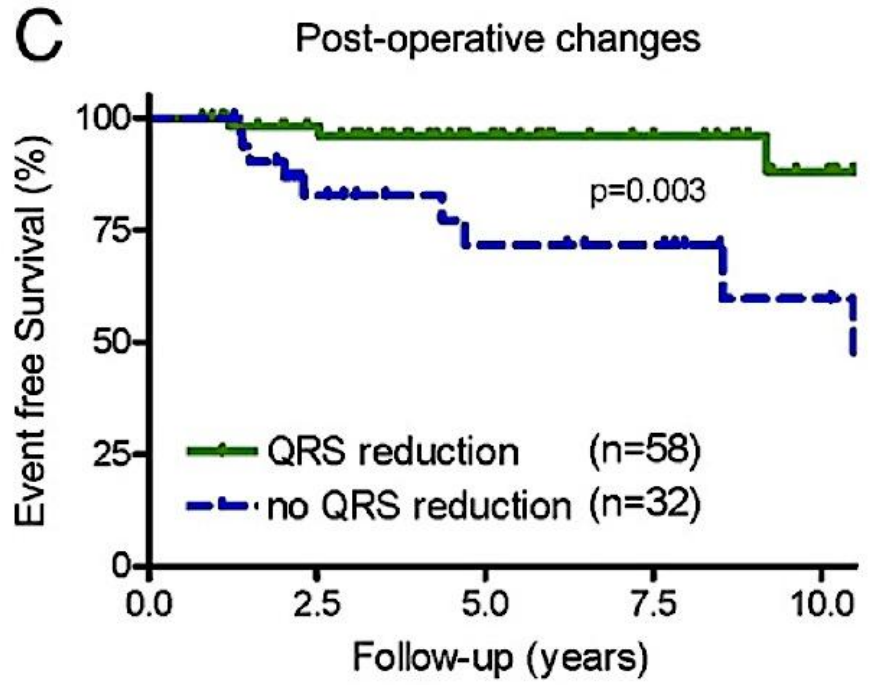
Perioperative and late mortality of pulmonary valve replacement after TOF

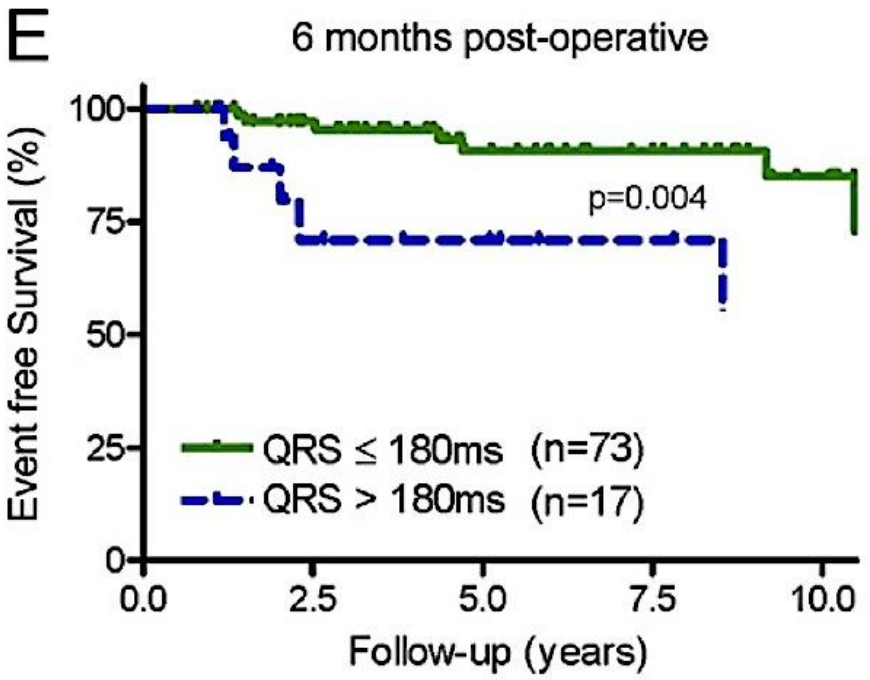
Institution	Year	Number of patient	Operative death	Average Length of Follow up Time (year)	Late Death or Transplantation
SUNY, Syracus	1985	11	0	1	0
Children's Memorial Hospital, Chicago	1997	49	1	5.8	3
University of Toronto	1997	85	1		
Mayo Clinic	2001	42	1		
Children's Hospital, Atlanta	2002	100	1	49	1
Leiden University, The Netherlands	2002	26	0	1,5	1
New England Med Center, Boston	2003	36	0	5	1
University of Zurich, Switzerland	2005	39	0	1.25	0
Multicenter, The Netherlands	2006	158	0	4.2	2
University of Toronto	2007	82	0	8.8	2
University Medical Center, Rotterdam	2008	17	0	6.4	0
International Society of Congenital Heart Disease	2008	93	0	3	2
Great Ormond Street, London	2008	71	0	1	0
Emony University	2009	107	3		
Children's Hospital, Boston	2009	77	0	2.8	6
Children's Hospital, Atlanta	2010	42	0	2.2	0
		1035	**0.68%**		**2.2%**

Geva JCMR 2011, 13:9



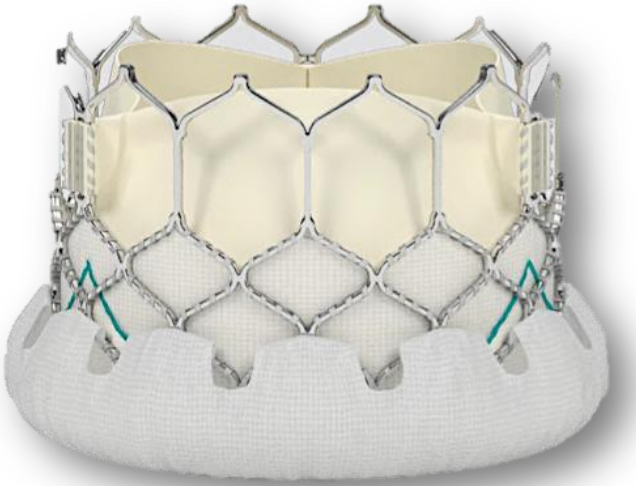




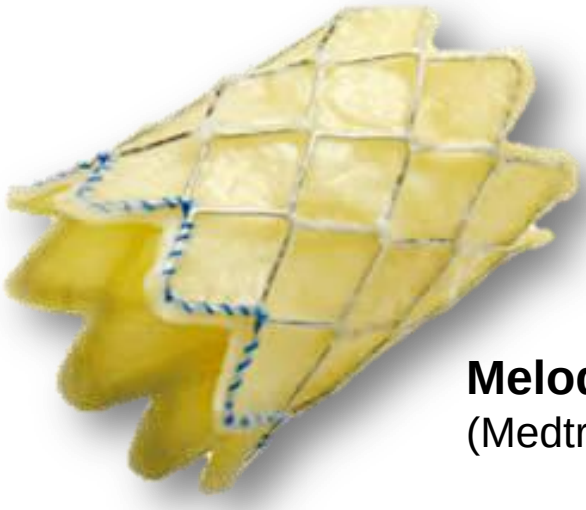


Roderick W, et al. JACC 2010;56:1486–92

Percutaneous valve implantation



Edwards SAPIEN™ Valve
(Edwards Lifescience)



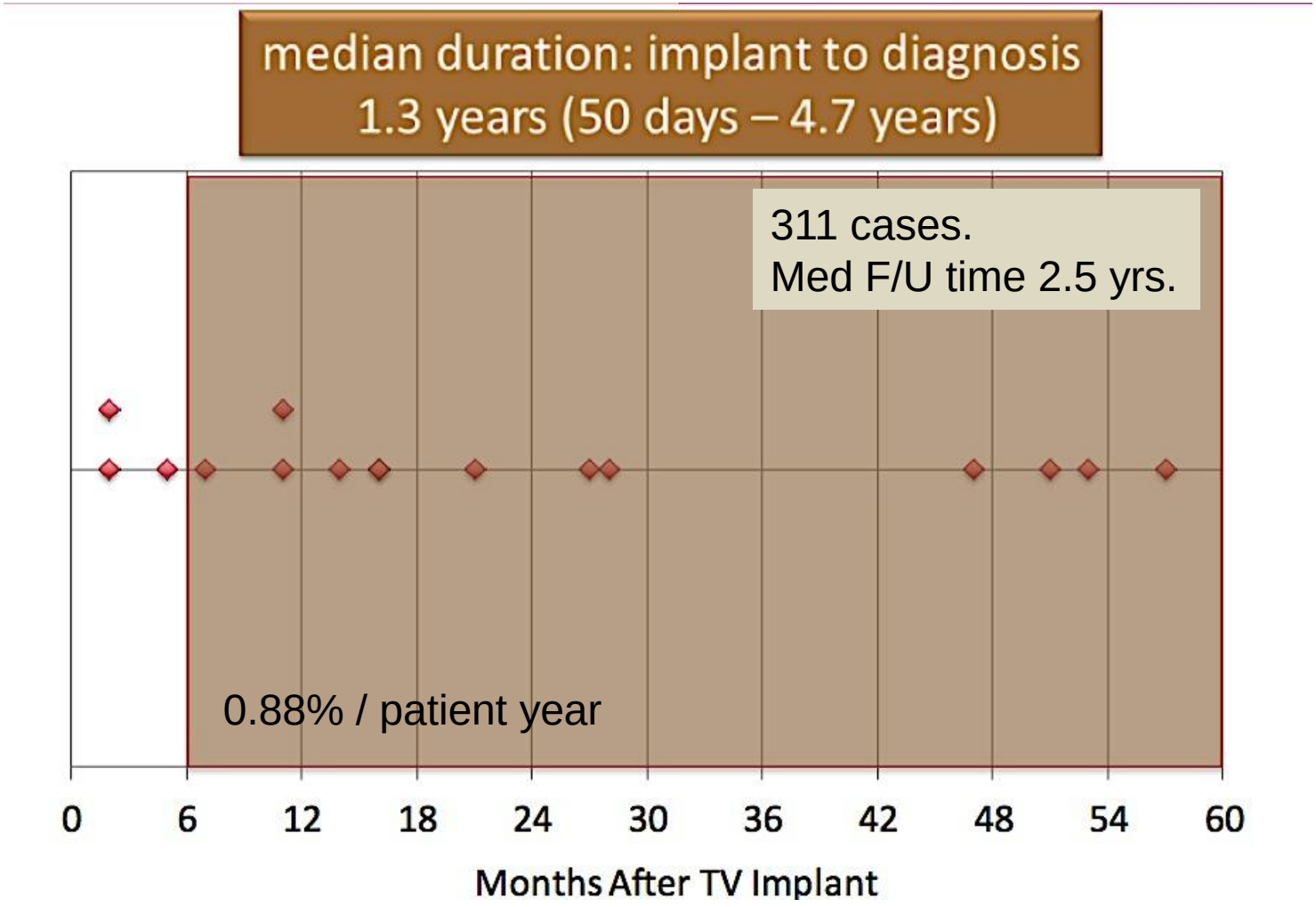
Melody™ Valve
(Medtronic)

Venus P-valve
(Venus MedTech)

Percutaneous pulmonary valve implantation

	Year	Valve	Number of patient	Operative death	Average Length of Follow up Time (month)	Late Death
Italian Society of Pediatric Cardiology	2013	Melody™	63	0	30	1
Gillespie MJ, et al.	2012	Melody™	104	0	12	0
COMPASSION study	2010	SAPIEN™	33	0	6	0

Melody™ Valve Endocarditis



McElhinney DB, et al. Circ Cardiovasc Interv 2013;6: 292-300

Zahn E, PCCS2013

Catheter Cardiovasc Interv. 2013 Jul 15. doi: 10.1002/ccd.25128. [Epub ahead of print]

Cost-analysis of percutaneous pulmonary valve implantation compared to surgical pulmonary valve replacement.

Vergales JE, Wanchek T, Novicoff W, Kron IL, Lim DS.

Division of Pediatric Cardiology, University of Virginia, Charlottesville, Virginia.

Abstract

OBJECTIVES: To perform cost evaluation and economic modeling of percutaneous pulmonary valve implantation (PPVI) compared to surgical revision.

BACKGROUND: While, PPVI appears to be a viable alternative to surgical conduit revision in select patients with right ventricular outflow tract anomalies, its overall economic burden has yet to be determined.

METHODS AND RESULTS: We examined the first 17 patients who underwent PPVI at our institution and compared them with the most-recently placed surgical valves. Economic data were obtained from the actual procedural and in-hospital charges and used as the base estimates for 5- and 10-year future modeling with appropriate sensitivity analysis. Median total hospital and procedural charges incurred by the patient were significantly higher for the surgical valve compared with PPVI ($126,406 ± $38,772 vs. $80,328 ± $17,387, P < 0.001). Median total societal charges were also higher for the surgical valve ($129,519 ± $39,021 vs. $80,939 ± $17,334, P < 0.001) owing to an average wage loss of $3,113 for surgical patients, contrasted to $611 who underwent PPVI, and a shorter length of stay (1.0 ± 0 vs. 5.7 ± 2.2, P <0.001) for PPVI. Sensitivity analysis determined that PPVI would need to fail at a rate of 17% per year (or 93% at 10 years) to lose its cost advantage.

CONCLUSIONS: PPVI holds a significant cost advantage over the surgical approach, fewer hospital days, and incurs less patient wage loss. Furthermore, it would need to have a very high failure rate at 10 years to lose its cost advantage.

KEYWORDS: congenital heart disease, cost-prediction, transcatheter valve implantation

PMID: 23857801 [PubMed - as supplied by publisher]

Procedure charge is ~ 50,000 USD cheaper for PPVI than surgery in Virginia

Conclusion

- **CXR is still a useful follow-up tool.**

- **Decision making depends on individual circumstances than a set of numbers from the tests.**
  - Time for valve replacement.
  - Surgery v/s intervention.