



PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

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2022



CARDIOCHIRURGIA

TRATTAMENTO DELLA DISFUNZIONE DEL TRATTO D'EFFLUSSO DESTRO

Alessandro Giamberti

Chief Congenital Cardiac Surgery Department

IRCCS Policlinico San Donato

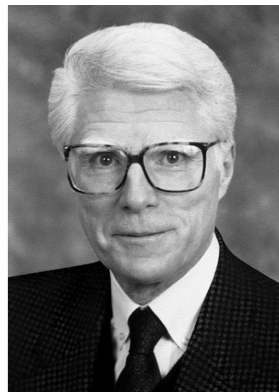


Management of RVOT dysfunction

“...today we can say that the pulmonary regurgitation after repair of Tetralogy of Fallot is not and will never be a great problem....”

AR Castaneda, JW Kirklin:

World Congress of Pediatric Cardiology and Cardiac Surgery, Paris, 1993

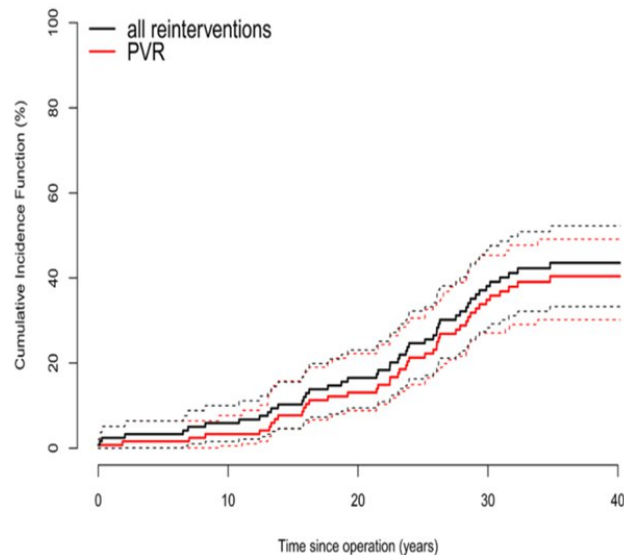
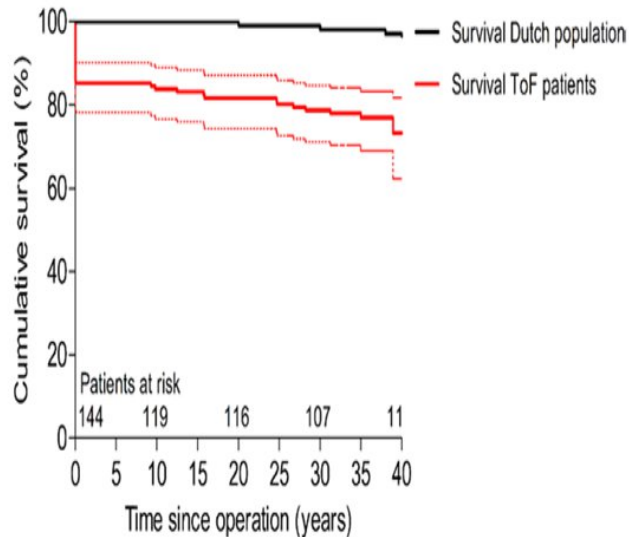




Management of RVOT dysfunction

Unnatural History of Tetralogy of Fallot: Prospective Follow-Up of 40 Years After Surgical Correction

Judith A.A.E. Cuypers, Myrthe E. Menting, Elisabeth E.M. Konings, Petra Opic, Elisabeth M.W.J. Utens, Willem A. Helbing, Maarten Witsenburg, Annemien E. van den Bosch, Mohamed Ouhlous, Ron T. van Domburg, Dimitris Rizopoulos, Folkert J. Meijboom, Eric Boersma, Ad J.J.C. Bogers and Jolien W. Roos-Hesselink

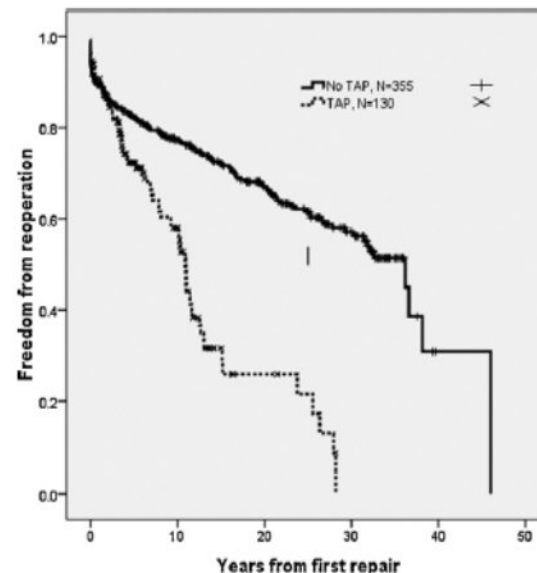




Management of RVOT dysfunction

Single-center 50 years' experience with surgical management of tetralogy of Fallot☆

Harald L. Lindberg, Kjell Saatvedt*, Egil Seem, Tom Hoel, Sigurd Birkeland



Management of RVOT dysfunction



CHRONIC PULMONARY REGURGITATION PATHOPHYSIOLOGY

FUNCTIONAL TR
(secondary)



**TV annulus
dilatation**



Chronic RV volume load



RV dilatation



↓RV mass/volume ratio



↑RV wall stress



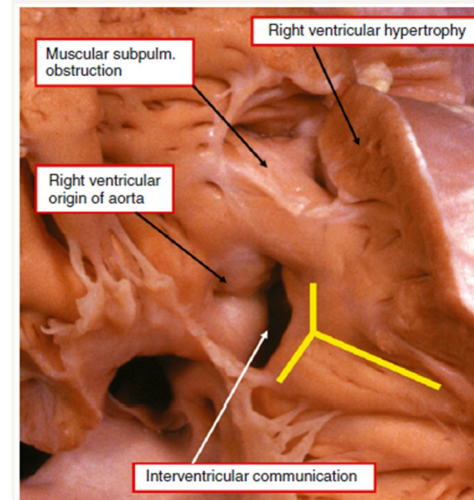
RV DYSFUNCTION

Management of RVOT dysfunction



TOF surgical repair should ideally result in:

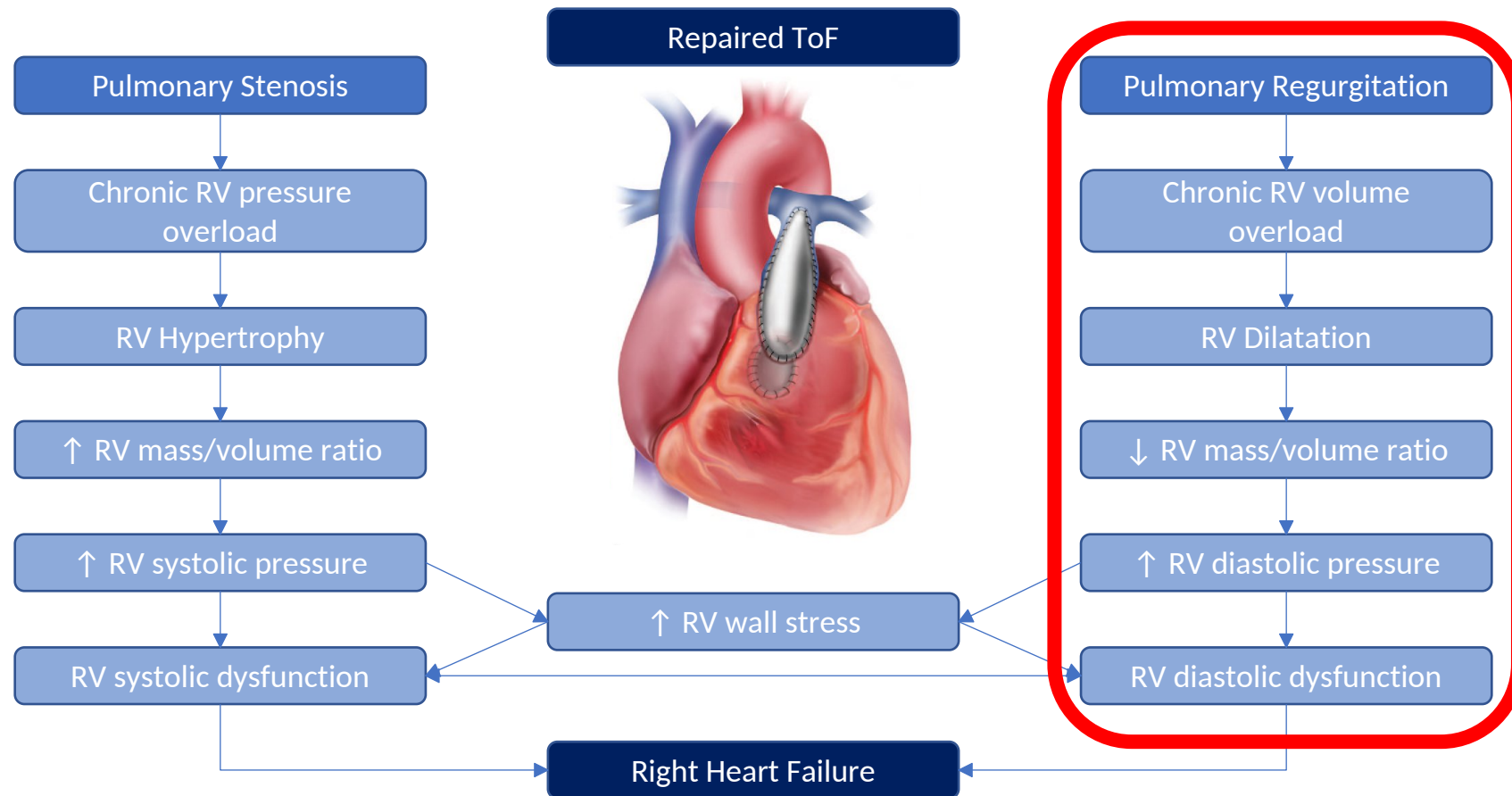
1. Complete closure of VSD (respecting the TV)
2. Preservation of RV form and function
3. Obtaining an unobstructed RVOT
4. Incorporating a competent PV



The nature of RVOT rarely makes this possible

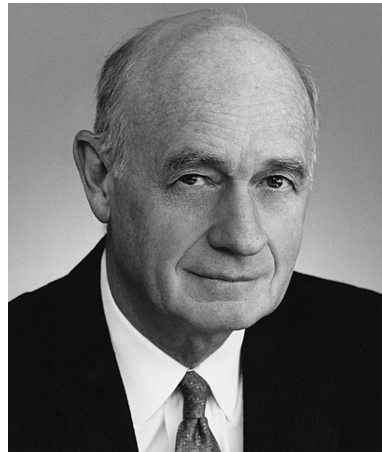


In the past 20 yrs we observed a shift from the need for complete relief of obstruction towards a policy to preserve the PV, even at the expence of a modeste residual stenosis





Management of RVOT dysfunction



Paul A. Ebert

Ebert PA

Second Operation for Pulmonary Stenosis or Insufficiency after repair of TF

Am J Cardiol 1982; 50:637-40

Misbach GA, Turley K, Ebert PA

Pulmonary Valve Replacement for Regurgitation after Repair of TF

Ann Thorac Surg. 1983; 36: 684-9



Management of RVOT dysfunction

Pulmonary Valve Implantation

Advantages

- 1) ↓ RVEDV without ↓ RVEF
- 2) Improvement of mass/volume ratio
- 3) Improvement of EKG parameters (QRS duration)
- 4) Improvement of exercise intolerance
- 5) Very low surgical risk

PVI has not yet been shown to increase patient lifespan !!



Role of Pulmonary Valve Implantation

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ISSN 0735-1097/00/\$20.00
PII S0735-1097(00)00930-X

Adult Congenital Heart Disease

Pulmonary Valve Replacement in Adults Late After Repair of Tetralogy of Fallot: Are We Operating Too Late?

Judith Therrien, MD, FRCP(C), Samuel C. Siu, MD, FRCP(C), Peter R. McLaughlin, MD, FRCP(C), Peter P. Liu, MD, FRCP(C), William G. Williams, MD, FRCS(C), Gary D. Webb, MD, FRCP(C)

Toronto, Canada

Difficult patient's selection and pre op evaluation





Management of RVOT dysfunction

Biventricular Response After Pulmonary Valve Replacement for Right Ventricular Outflow Tract Dysfunction

Is Age a Predictor of Outcome?

Alessandra Frigiola, MD; Victor Tsang, MD, FRCS; Catherine Bull, MRCP; Louise Coats, MRCP;
Sachin Khambadkone, MD, MRCP; Graham Derrick, MD, MRCP; Bryan Mist, PhD;
Fiona Walker, FRCP; Carin van Doorn, MD, FRCSC(Th); Philipp Bonhoeffer, MD;
Andrew M. Taylor, MD, MRCP, FRCR

Conclusions—A relatively aggressive PVR policy (end diastolic volume $<150 \text{ mL/m}^2$) leads to normalization of right ventricular volumes, improvement in biventricular function, and submaximal exercise capacity. Normalization of ventilatory response to carbon dioxide production is most likely to occur when surgery is performed at an age ≤ 17.5 years. This is also associated with a better left ventricular filling and systolic function after surgery. (*Circulation*. 2008; 118[suppl 1]:S182–S190.)

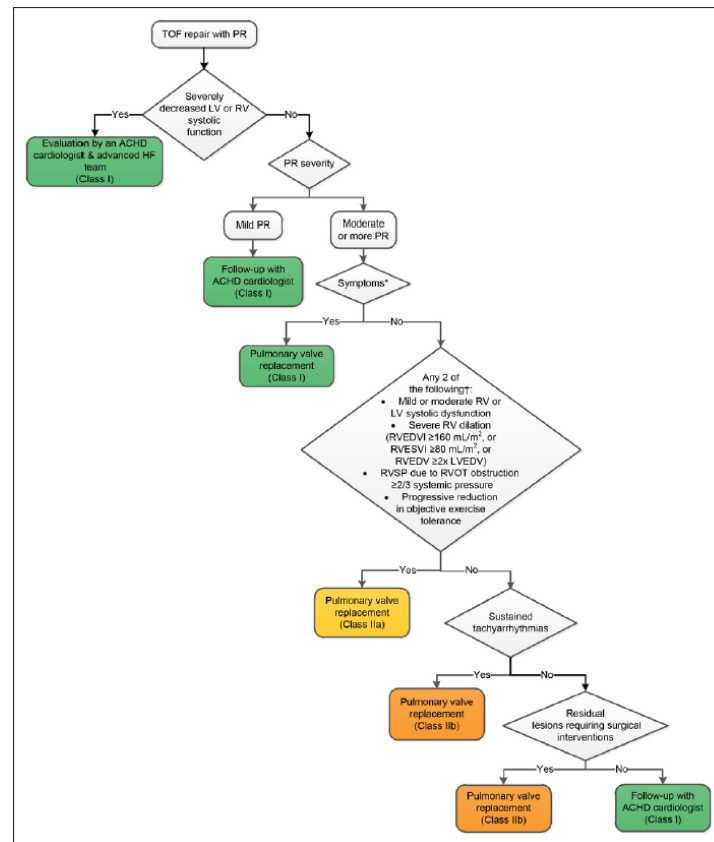
PVI has not yet been shown to increase patient lifespan !!



2018 AHA/ACC Guideline for the Management of Adults With Congenital Heart Disease

Pulmonary Valve Replacement indication

- **SYMPTOMATIC** patients with moderate or severe PR
- **ASYMPTOMATIC** patients with moderate or severe PR and at least 2 of the following:
 - Decrease in objective exercise capacity
 - $RVESVi \geq 80 \text{ ml/m}^2$, $RVEDVi \geq 160 \text{ ml/m}^2$, $RVEDV \geq 2 \times LVEDV$
 - Mild or moderate RV or LV dysfunction
 - $RVSP \geq 2/3 \text{ LVSP}$ due to RVOTO
- **ASYMPTOMATIC** patients with moderate or severe PR and sustained tachyarrhythmias





2020 ESC Guidelines for the management of adult congenital heart disease


ESC

 European Society
of Cardiology

European Heart Journal (2020) 00, 1–83

doi:10.1093/eurheartj/ehaa554

Pulmonary Valve Replacement indication

- **SYMPTOMATIC** patients with severe PR (CMR RF >30-40%) and/or at least moderate RVOTO (echo Vmax >3m/s)
- **ASYMPTOMATIC** patients with severe PR and/or RVOTO
 - Decrease in objective exercise capacity
 - RVESVi ≥ 80 ml/m², RVEDVi ≥ 160 ml/m², TR progression (at least moderate)
 - Progressive RV systolic dysfunction
 - RVOTO with RVSP >80 mmHg

Recommendations for intervention after repair of tetralogy of Fallot

Recommendations	Class ^a	Level ^b
PVRep is recommended in symptomatic patients with severe PR ^c and/or at least moderate RVOTO. ^d	I	C
In patients with no native outflow tract, ^e catheter intervention (TPVI) should be preferred if anatomically feasible.	I	C
PVRep should be considered in asymptomatic patients with severe PR and/or RVOTO when one of the following criteria is present. <ul style="list-style-type: none"> • Decrease in objective exercise capacity. • Progressive RV dilation to RVESVi ≥ 80 mL/m², and/or RVEDVi ≥ 160 mL/m²^f, and/or progression of TR to at least moderate. • Progressive RV systolic dysfunction. • RVOTO with RVSP >80 mmHg. 	IIa	C

Management of RVOT dysfunction



Europe: **2.3 million pts**

1.9 million pts

Moons P et al, Eur Heart J 2010;31:1301-5

20% of CHD have anomalies affecting RVOT plus Ross patients



Half million pts on theoretical need of PVI

Management of RVOT dysfunction



Pediatr Cardiol (2013) 34:1190–1193
DOI 10.1007/s00246-012-0602-3

ORIGINAL ARTICLE

Porcine Bioprosthetic Valve in the Pulmonary Position: Mid-Term Results in the Right Ventricular Outflow Tract Reconstruction

Alessandro Giamberti · Massimo Chessa · Matteo Reali ·
Alessandro Varrica · Halkawt Nuri · Giuseppe Isgrò ·
Alessandro Frigiola · Marco Ranucci

Morbidity and Mortality Risk Factors in Adults With Congenital Heart Disease Undergoing Cardiac Reoperations

Alessandro Giamberti, MD, Massimo Chessa, MD, PhD, Raul Abella, MD,
Gianfranco Butera, MD, Concetta Carlucci, MD, Halkawt Nuri, MD,
Alessandro Frigiola, MD, and Marco Ranucci, MD

Department of Cardiac Surgery and Grown Up Congenital Heart Unit and Department of Cardiothoracic-Vascular Anesthesia and Intensive Care Unit, Istituto di Ricovero e Cura a Carattere Scientifico, Policlinico San Donato, San Donato Milanese, Milan, Italy

Giamberti et al. Ann Thorac Surg 2009; 88: 1284-90

“The PVI for PVR is still the most frequent reoperation performed today despite the recent introduction of the transcatheter pulmonary valve”

“ The surgical implantation of a PV in an adult pt is still a palliative procedure”



GRUPPO OSPEDALIERO
SAN DONATO



Transcatheter Implantation of a Bovine Valve in Pulmonary Position A Lamb Study

Philipp Bonhoeffer, MD; Younes Boudjemline, MD; Zakhia Saliba, MD; Ana Olga Hausse, MD;
Yacine Aggoun, MD; Damien Bonnet, MD; Daniel Sidi, MD; Jean Kachaner, MD

Circulation. 2000;102:813-816

EARLY REPORT

Early report

Percutaneous replacement of pulmonary valve in a right-ventricle to pulmonary-artery prosthetic conduit with valve dysfunction

Philipp Bonhoeffer, Younes Boudjemline, Zakhia Saliba, Jacques Merckx, Yacine Aggoun, Damien Bonnet, Philippe Acar,
Jérôme Le Bidois, Daniel Sidi, Jean Kachaner

Lancet 2000; **356**: 1403-05





Melody valve
(2000)



Sapien valve
(2006)



Venus P valve
(2013)



Harmony valve
(2017)



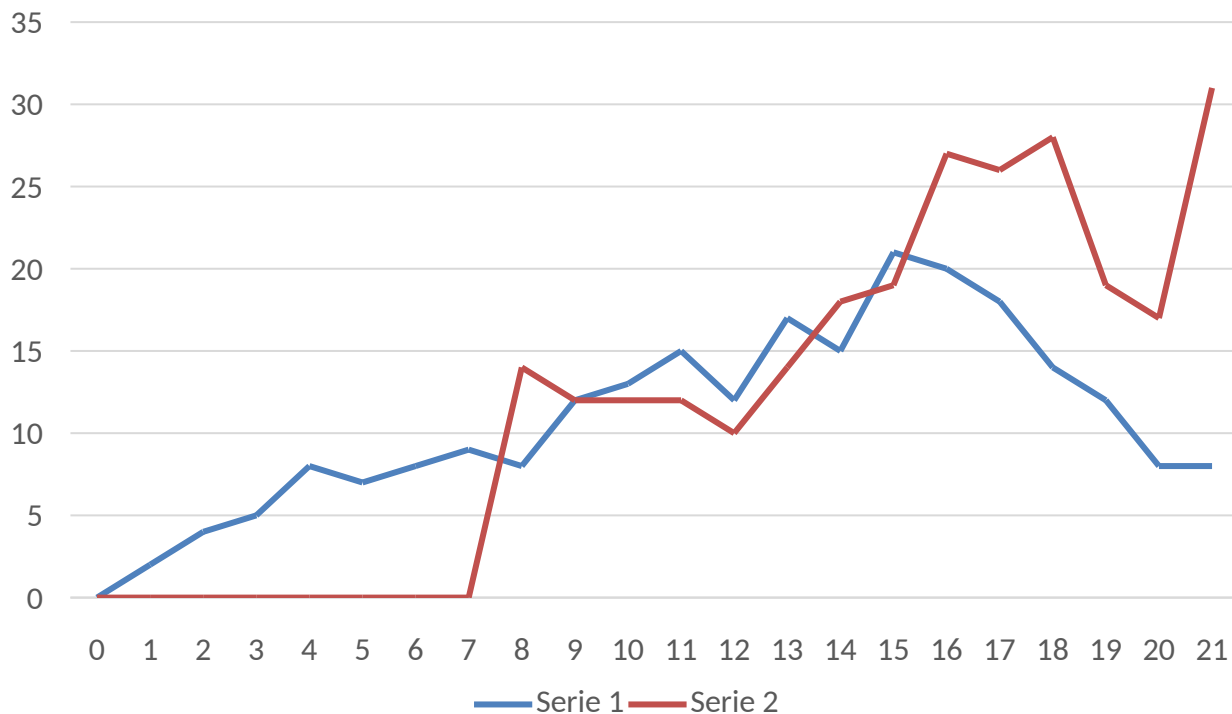
Alterra Adaptive
(2018)



Evolution of Transcatheter Pulmonary Valves



Surgical vs transcatheter PVI



IRCCS Policlinico San Donato experience



Management of RVOT dysfunction

HOW TO BE EFFECTIVE AT REOPERATION TIME FOR PVR

- Choosing the “IDEAL” pulmonary valve
- Treating the Associated Cardiac Malformations

Management of RVOT dysfunction



Choosing the “*IDEAL*” pulmonary valve

*“Who is not a good candidate today for a transcatheter approach can be **a good candidate in the future**”*

*Today the best surgical approach is.....
to prepare the road to a percutaneous procedure*

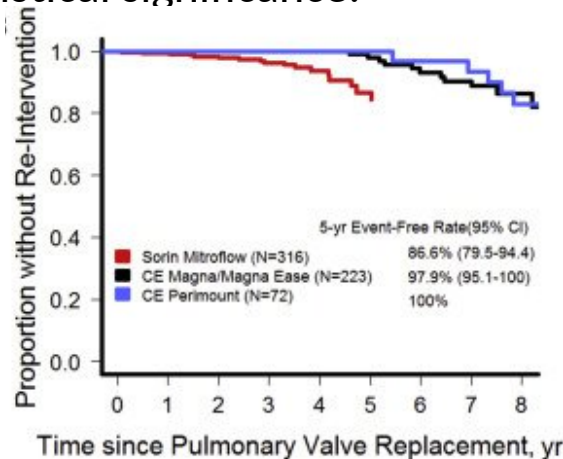




Management of RVOT dysfunction

BIOPROSTHETIC VALVE

- Available in all sizes.
- Durability similar or homograft. Freedom from reoperation 85% at 10 years.
- Porcine valves seem to be more durable than bovine bioprosthesis, even though the majority of studies did not reach statistical significance.
- Very easy to implant.
- No anticoagulation therapy
- Good candidate for future tPVI: valve in valve
- Valve preferred by most surgeons

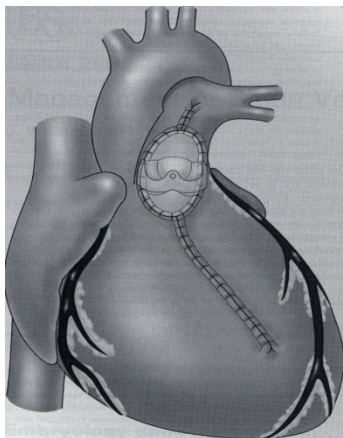




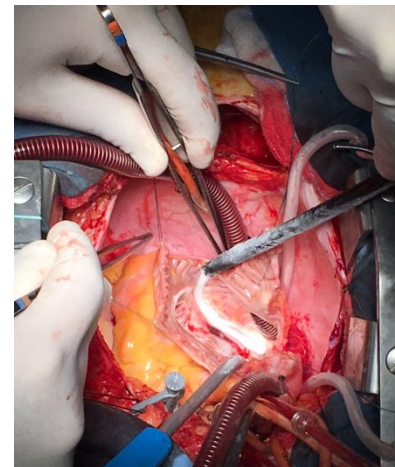
Management of RVOT dysfunction

Treating the Associated Cardiac Malformations

- ***RV dilatation/aneurism***
- ***Functional Tricuspid Valve regurgitation***
- ***Supra or ventricular arrhythmias***



- ***RV remodeling/plication***
- ***Tricuspid valve repair***
- ***Arrhythmia surgery***



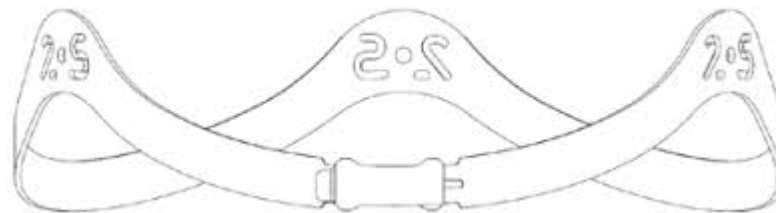


THE FUTURE?

**Does tomorrow's technology
influence today's surgical approach?**



Management of RVOT dysfunction



INSPIRIS Resilia valve

Edwards Lifesciences

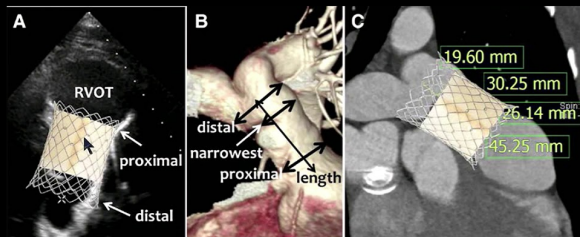


Management of RVOT dysfunction



01:56

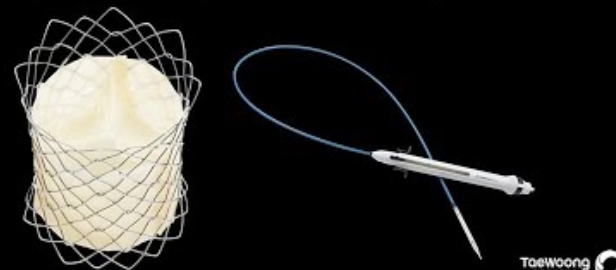
Pulsta valve fit for main PA loading zone



(Kim GB et al. Circ Cardiovasc Interv. 2018;11:e006494)

Transcatheter Pulmonary Valve

PULSTA™ Transcatheter Pulmonary Valve



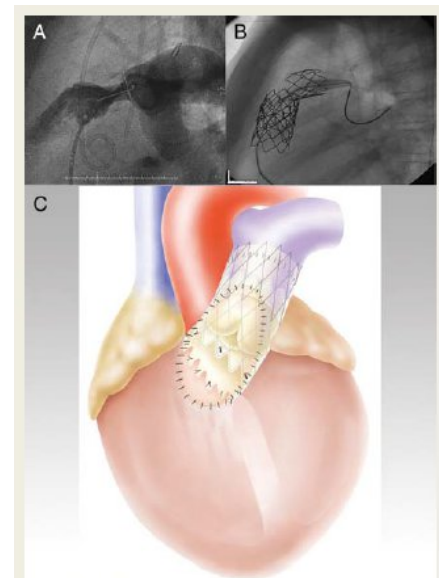
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Management of RVOT dysfunction

Future Surgical Options

- EXPANDABLE STENT AROUND THE PATCHED RVOT?
- PA PREVENTIVE RIGID BANDING?
- SURGICAL IMPLANTATION OF A MELODY?



CARDIOVASCULAR FLASHLIGHT

doi:10.1093/eurheartj/ehs146
Online publish-ahead-of-print 4 June 2012

Surgical recycling of a percutaneously implanted Melody valve

Hitendu Dave¹*†, Oliver Kretschmar²†, and René Prêtre¹

¹Division of Congenital Cardiovascular Surgery, University Children's Hospital Zurich; and ²Division of Paediatric Cardiology, University Children's Hospital Zurich, Steinwiesstrasse 75, 8032, Zurich, Switzerland



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Management of RVOT dysfunction

Conclusions

- The surgical PVI was the most frequent reoperation performed in ACHD related the big efforts to the introduction of new transcatheter devices
- The time of surgical PVI in the adulthood is a “second chance” for the surgeon in the attempt to reduce reoperations
- The new technologies should be taken into consideration by the surgeon planing the surgical approach
- Surgical or trancatherer procedures are still palliative procedures
- We are still very far from having definitively solved the RVOT dysfunction problem

Management of RVOT dysfunction



...thank you very much for the attention !!