

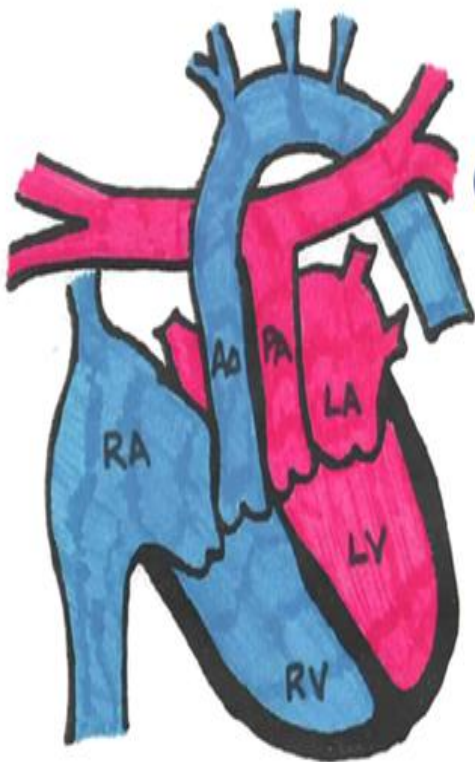


14 febbraio 2014

Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

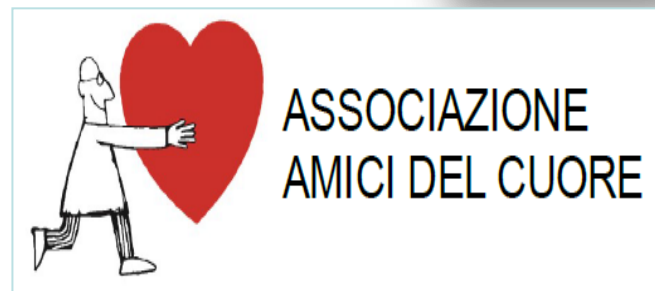
LA CARDIOPATIA CONGENITA:

DALLA
GRAVIDANZA
ALL'ETÀ
ADULTA



Giorgio Faganello

Ambulatorio delle Cardiopatie Congenite dell'Adulto
Centro Cardiovascolare, Trieste



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Requisiti preliminari all'indagine CMRI

- **Tomografo performante (1.5-3 T)**
- Radiologo-TSRM dedicati alla cardio-RM (complessità tecnologica)
- Stretta collaborazione col cardiologo inviante (indicazione-indirizzo clinico all'indagine) (Disponibilità monitoraggio)
- Stretta collaborazione col paziente (Claustrofobia - Apnea)
- Esclusione delle controindicazioni assolute
 - All'esposizione a campi magnetici
 - Ai test da stress farmacologici



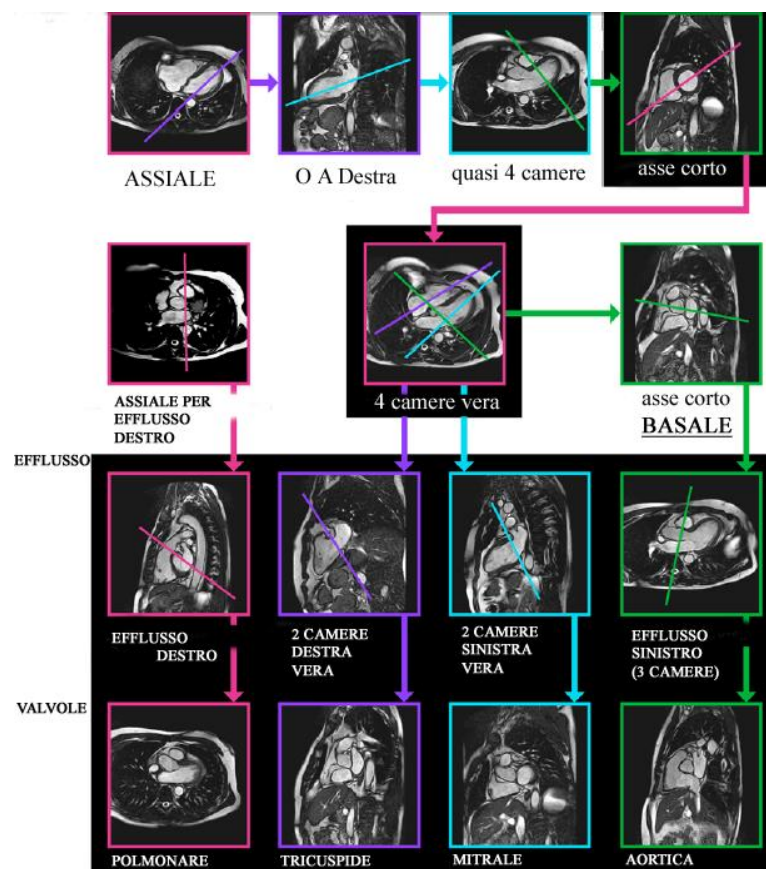
I : 1.5 T
IG : 30.0 mT/m
SR: 75 mT/m/ms
RT: 400 μ s



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Requisiti preliminari all'indagine CMRI

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 - **Ai test da stress farmacologici**

Current clinical applications

- ❑ Function: Assessment of left and right ventricular volumes and mass, as well as systolic function
- ❑ Perfusion: Myocardial perfusion
- ❑ Viability: Assessment of myocardial viability
- ❑ Congenital heart disease: shunt calculation
- ❑ Valvular disease Evaluation and follow-up
- ❑ Cardiac masses
- ❑ Ischemic cardiomyopathies
- ❑ Nonischemic cardiomyopathies
- ❑ Arrhythmogenic right ventricular cardiomyopathy
- ❑ Dilated cardiomyopathy
- ❑ Hypertrophic cardiomyopathy
- ❑ Myocarditis, sarcoidosis
- ❑ Pericardial disease
- ❑ Aortic disease

Emerging applications

- ❑ • Coronary angiography
- ❑ • Interventional magnetic resonance

Journal of the American College of Cardiology
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Published by Elsevier Inc.



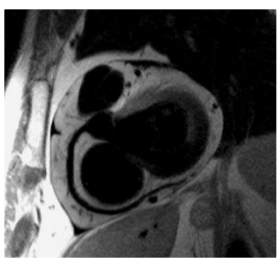
Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

[J Am Soc Echocardiogr.](#) 2013 Aug;26(8):813-27. doi: 10.1016/j.echo.2013.05.006. Epub 2013 Jun 13.

Can we talk? Reflections on effective communication between imager and interventionalist in congenital heart disease.

[Kutty S](#), [Delaney JW](#), [Latson LA](#), [Danford DA](#).

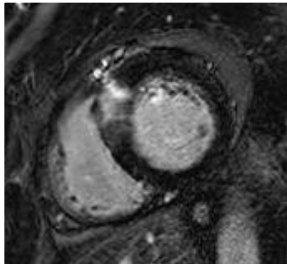




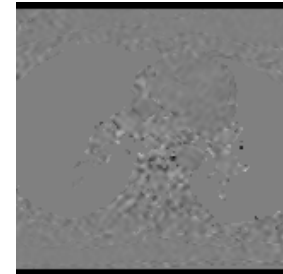
Morfologia

Segnale

Vitalità



Flusso

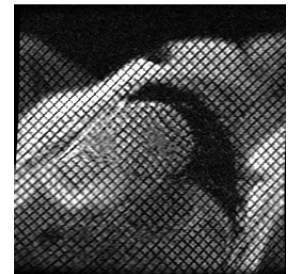
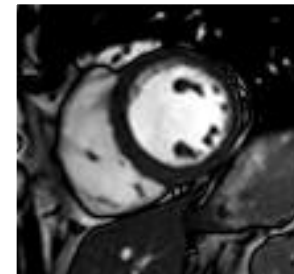


**Necessità di mirare
l'indagine !**

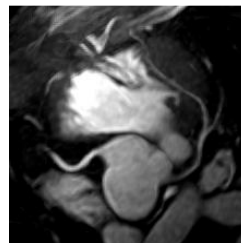
Perfusione



Funzione/Cinetica



Coronarografia



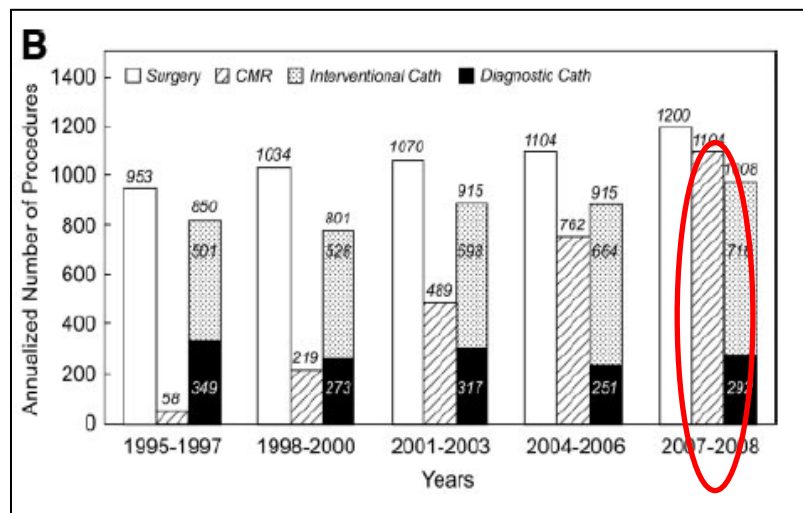
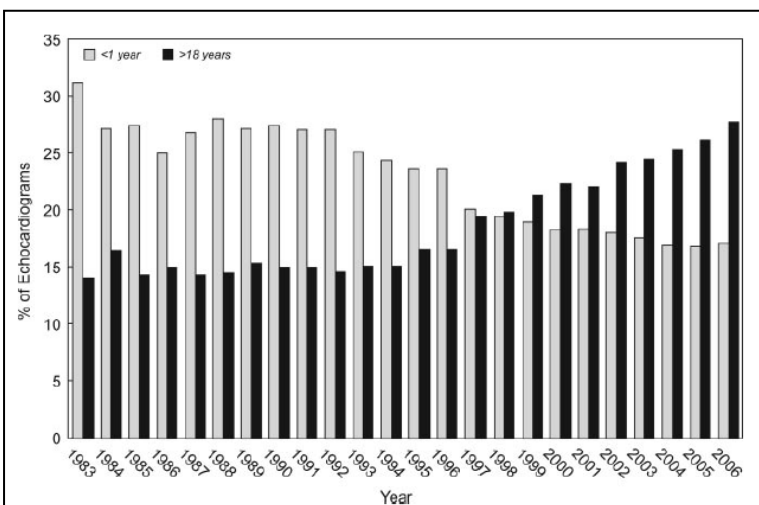
Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Advances in Cardiovascular Imaging

Multimodality Noninvasive Imaging for Assessment of Congenital Heart Disease

Ashwin Prakash, MD; Andrew J. Powell, MD; Tal Geva, MD

Circ Cardiovasc Imaging. 2010;3:112-125.



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Pediatr Radiol (2006) 36 (Suppl 2): 121–125
DOI 10.1007/s00247-006-0191-5

ALARA

Ruth A. Kleinerman

Cancer risks following diagnostic and therapeutic radiation exposure in children

Congenital heart disease

Cumulative patient effective dose and acute radiation-induced chromosomal DNA damage in children with congenital heart disease

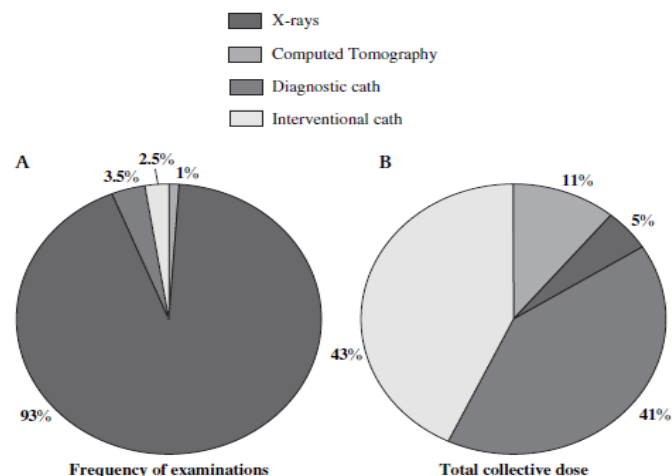
Lamia Ait-Ali,^{1,2} Maria Grazia Andreassi,^{1,2} Ilenia Foffa,^{1,2} Isabella Spadoni,²
Eliseo Vano,³ Eugenio Picano¹

Heart 2010;**96**:269–274.



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Figure 1 The most frequent examinations and total collective dose in congenital heart disease: relative contribution of conventional radiographs, CT, diagnostic catheterisation and interventional radiology to (A) the frequency and (B) the total collective effective dose.



our patients with CHD for three reasons. First, adult grown-up patients with surgically repaired CHD are a large and growing population, estimated to be one million in US in the year 2000, compared with an estimated 300 000 in 1980, and 1.4 million are expected by 2020.³⁹ Second, the long-term outcome of the underlying cardiac disease has been dramatically improved by interventions in the past decade, and now excellent long-term survival is the rule, rather than the exception.^{9 10} Third, and most importantly, children are several times more sensitive to radiation than middle-aged adults.^{1 3 11 12} Therefore, when managing



Level 3 Certified			
Family Name	First Name	Country	Certified until
Westwood	Mark	United Kingdom	2018
Wassmuth	Ralf	Germany	2018
WACKER	Christian	Germany	2018
von Knobelsdorff	Florian	Germany	2018
Thiele	Holger	Germany	2018
Steadman	Christopher	United Kingdom	2018
Sorahb	Fratz	Germany	2018
Sechtem	Udo	Germany	2018
Schuster	Andreas	Germany	2018
Petryka	Joanna	Poland	2018
PETERSEN	Steffen	United Kingdom	2018
Pellaton	Cyril	United Kingdom	2018
Paetsch	Ingo	Germany	2018
Muellerleile	Kai	Germany	2018
Marcotte	Francois	Canada	2018
Manka	Robert	Switzerland	2018
Mahrholdt	Heiko	Germany	2018
Maceira	Alicia M.	Spain	2018
LOPEZ	MARIA PILAR	Spain	2018
Lee	Alison	United Kingdom	2018
Kidambi	Ananth	United Kingdom	2018
Kelle	Sebastian	Germany	2018
Karamits	Theodoros	Greece	2018
Jahnke	Cosima	Germany	2018
Groenink	Maarten	The Netherlands	2018
Greenwood	John	United Kingdom	2018
GERBER	Bernhard	Belgium	2018
Gebker	Rolf	Germany	2018
Eitel	Ingo	Germany	2018
Crilley	Jenifer	United Kingdom	2018
Chiribiri	Amedeo	United Kingdom	2018
Bucciarelli-Ducci	Chiara	United Kingdom	2018
Bettencourt	Nuno	Portugal	2018
Bernhardt	Peter	Germany	2018
Bathgate	Brigitte	Germany	2018
Alpendurada	Francisco	United Kingdom	2018
Almeida	Ana	Portugal	2018
Level 2 Certified			
BINDER	Germany	2018	



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Quale ruolo della RISONANZA MAGNETICA CARDIACA
nell'Ambulatorio GUCH?



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

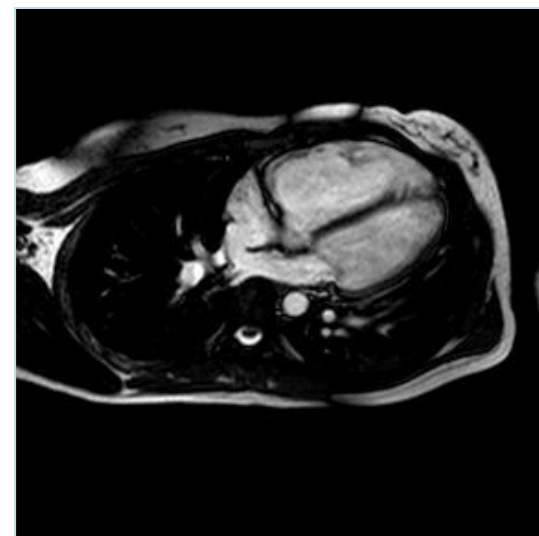
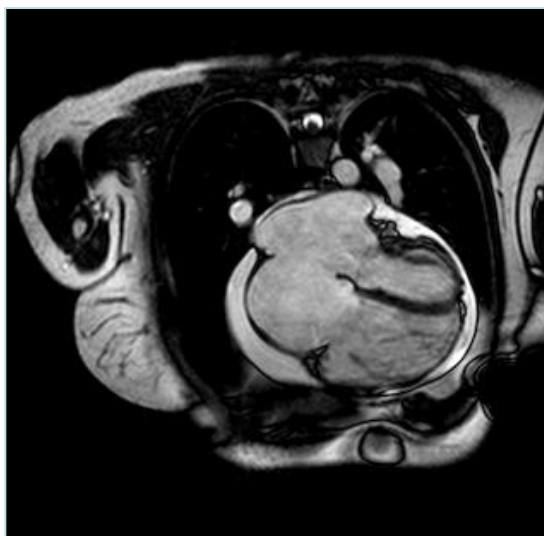
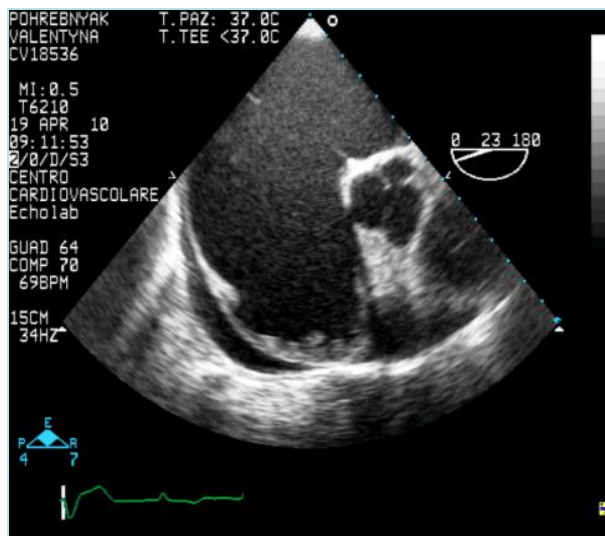
RISONANZA MAGNETICA CARDIACA

- ❑ Valutazione morfologica
- ❑ Valutazione della funzione destra-sinistra e della massa
- ❑ Valutazioni flussimetriche
- ❑ Perfusion e Vitalità (late enhancement)



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

DIFETTO SETTO INTERATRIALE



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

RESEARCH

Open Access

Assessment of atrial septal defects in adults comparing cardiovascular magnetic resonance with transoesophageal echocardiography

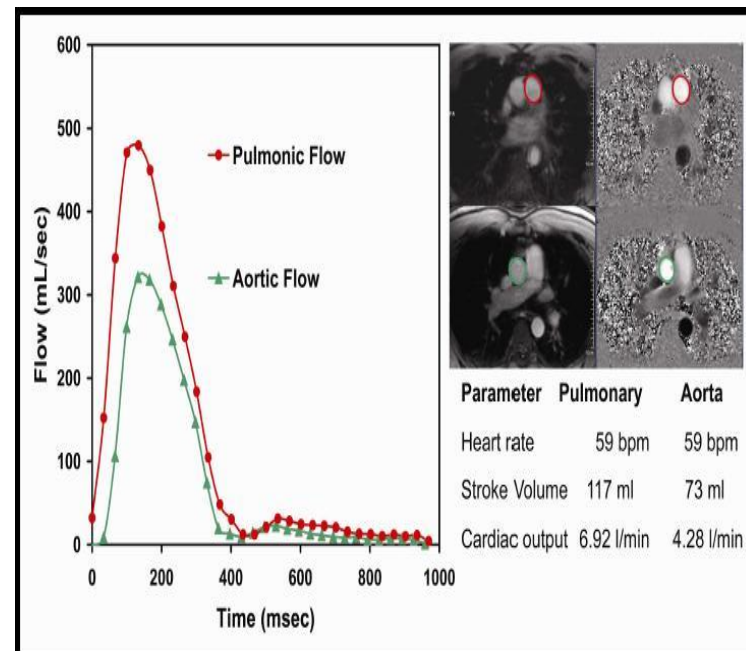
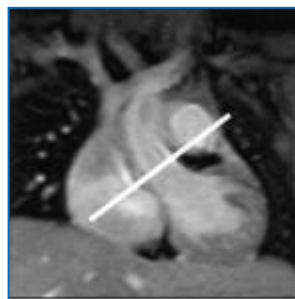
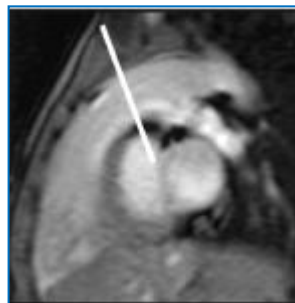
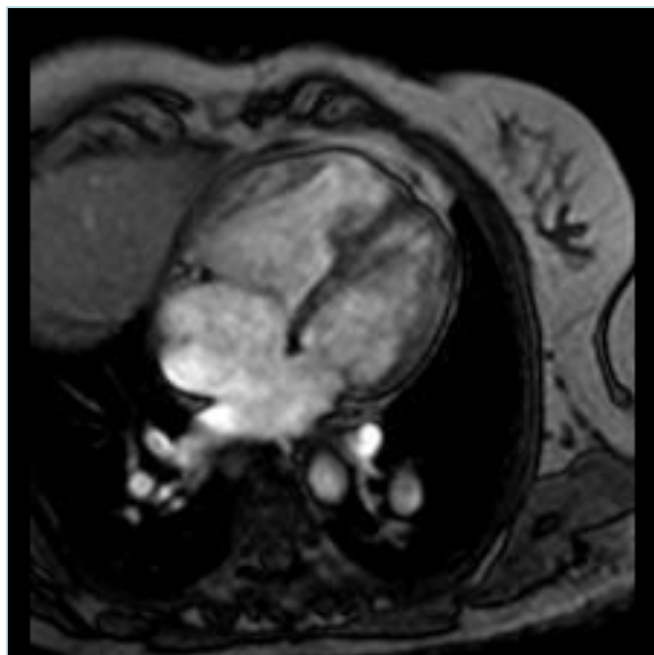
Karen SL Teo*, Patrick J Disney, Benjamin K Dundon, Matthew I Worthley, Michael A Brown, Prashanthan Sanders and Stephen G Worthley

	Able to be assessed by CMR (%)	Able to be assessed by TOE (%)
Maximal defect size	(20/20) 100%	(19/19) 100%
Anterior superior margin	(20/20) 100%	(15/19) 79%
Anterior inferior margin	(20/20) 100%	(17/19) 89%
Posterior superior margin	(19/20) 95%	(14/19) 74%
Posterior inferior margin	(20/20) 100%	(12/19) 63%



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Noninvasive Quantification of Left-to-Right Shunt in Pediatric Patients **Phase-Contrast Cine Magnetic Resonance Imaging Compared With Invasive Oximetry** *Circulation. 2001;103:2476-2482.*



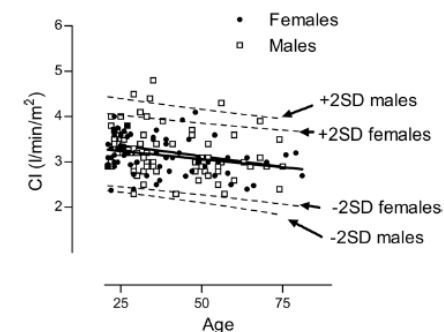
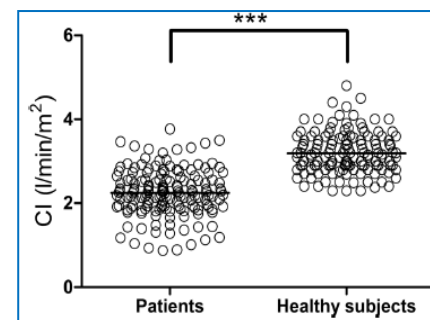
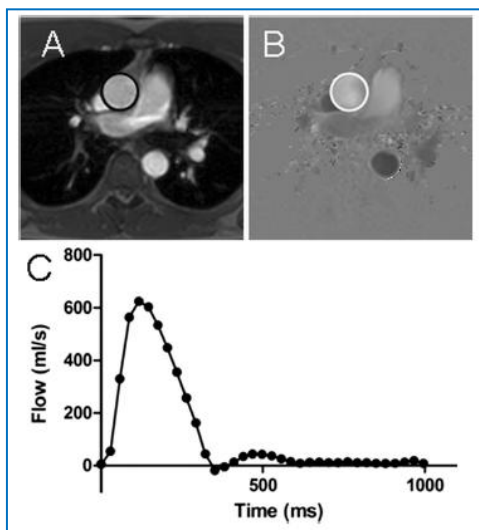
Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Cardiac output and cardiac index measured with cardiovascular magnetic resonance in healthy subjects, elite athletes and patients with congestive heart failure

Marcus Carlsson^{1*}, Ruslana Andersson¹, Karin Markenroth Bloch^{2,3}, Katarina Steding-Ehrenborg¹, Henrik Mosén¹, Freddy Stahlberg³, Bjorn Ekmechag⁴ and Hakan Arheden¹

Journal of Cardiovascular Magnetic Resonance 2012, **14**:51

Studio del Cardiac Index in
144 volontari sani
60 atleti
157 SCC pts



Conclusions: CI decreases in healthy subjects with age but does not differ between males and females. We found no difference in CI between athletes and healthy subjects at rest but CI was lower in patients with congestive heart failure. The presented values can be used as reference values for flow velocity mapping CMR.



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

ORIGINAL ARTICLE

The unnatural history of an atrial septal defect: Longitudinal 35 year follow up after surgical closure at young age

Cuypers JAAE, et al. *Heart* 2013;**99**:1346–1352

Table 4 Cardiac MRI

	ASD II	Sinus venosus defect	p Value
LV EDV/BSA, mean±SD (mL/m ²)	80±15	83±16	0.6
LV EDV dilation	5%	14%	0.3
LV ESV/BSA	33±10	36±11	0.4
LV ESV dilation	24%	43%	0.2
LV EF (%)	59±7	57±8	0.4
LV EF decreased	17%	29%	0.4
RV EDV/BSA	92±15	96±16	0.4
RV EDV dilation	17%	29%	0.4
RV ESV/BSA	44±10	48±11	0.2
RV ESV dilation	27%	57%	0.05
RV EF (%)	52±6	50±7	0.2
RV EF decreased	24%	50%	0.1

RV EF <49% and LV EF <54% were considered decreased and RV EDV >107.5 mL/m², RV ESV >47.2 mL/m², LV EDV >102.5 mL/m² and LV ESV >38.7 mL/m² were considered enlarged.
BSA, body surface area; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; LV, left ventricle; RV, right ventricle.

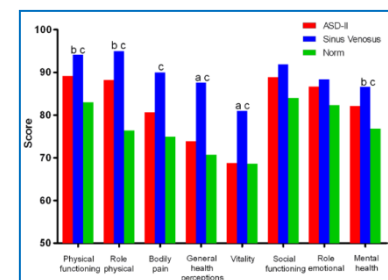
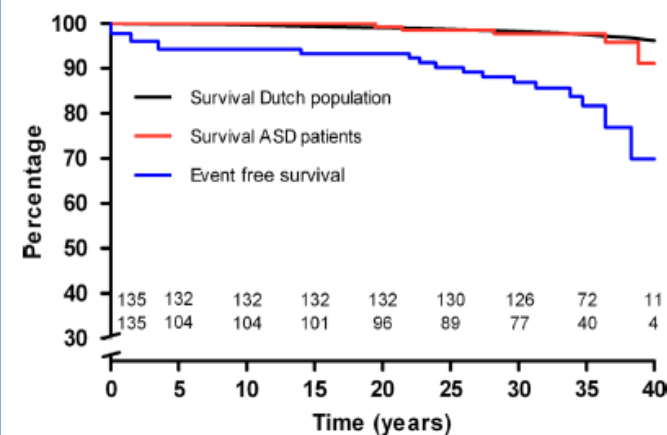
135 pts.
DIA trattati chirurgicamente
Fup 35 yrs

6% deceduti
16% aritmie sopraventricolari
6% PM impiantato
11% RV EDVi >107ml/mq

31% RVEF<49%

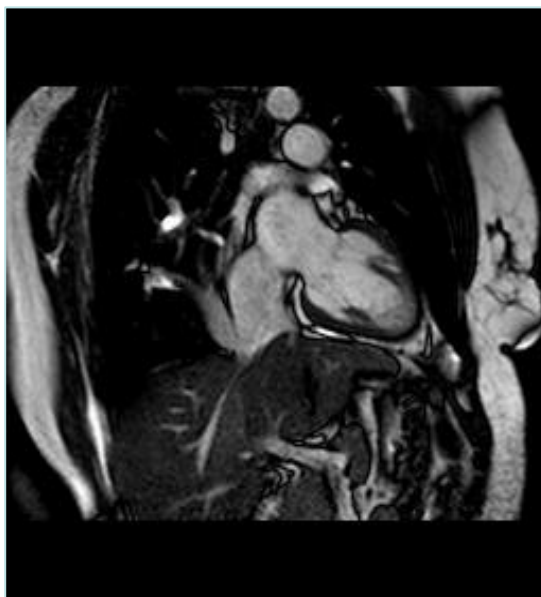
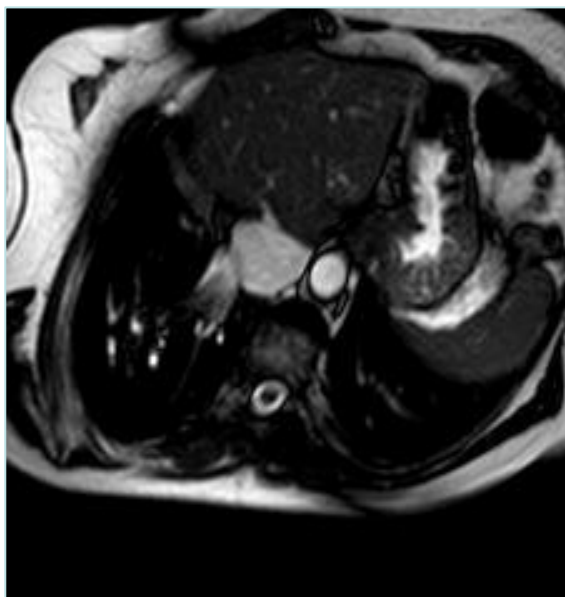


pacemaker implantation remains low. Although RVEF was unexpectedly found to be decreased in one-third of patients, the functional status remains excellent.



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RITORNO VENOSO ANOMALO



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doi:10.1093/mmcts/mmt001 published online 7 February 2013.

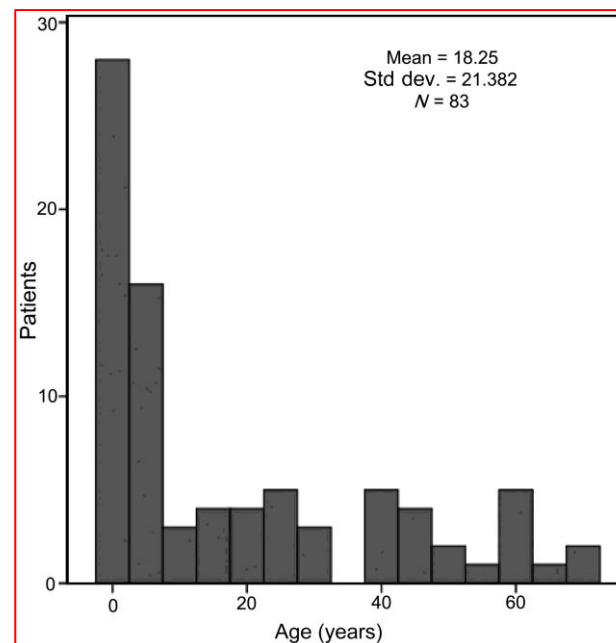
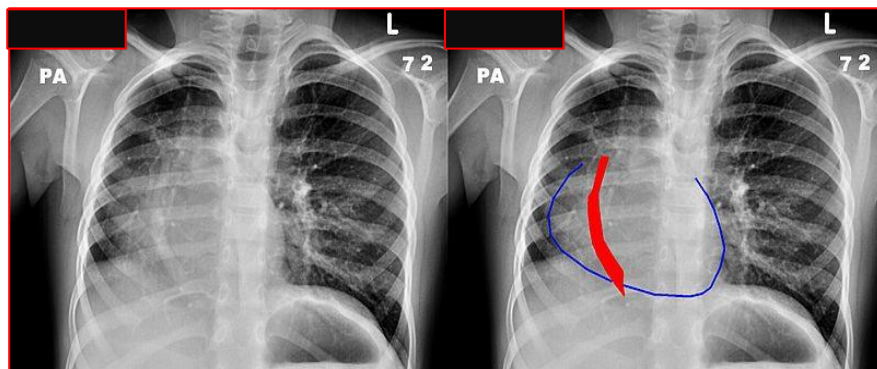


MULTIMEDIA MANUAL OF
**CARDIO-THORACIC
SURGERY**

Partial anomalous pulmonary venous connection (including scimitar syndrome)

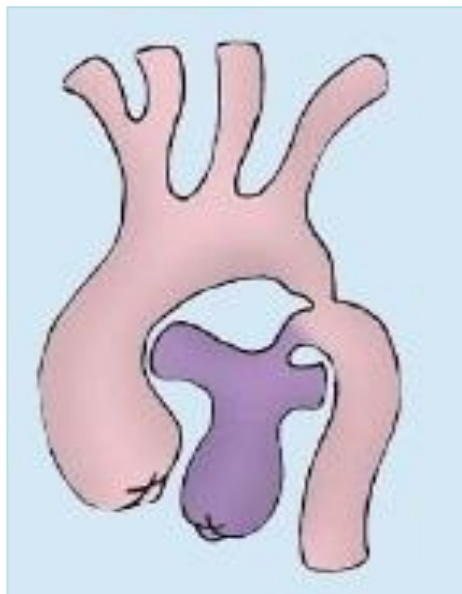
Pieter C. van de Woestijne*, Niels Verberkmoes and Ad J.J.C. Bogers

Department of Cardiothoracic Surgery, Erasmus University Medical Center, Rotterdam, Netherlands

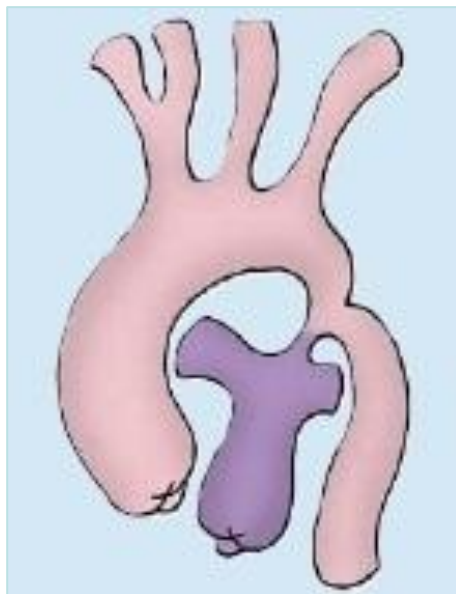


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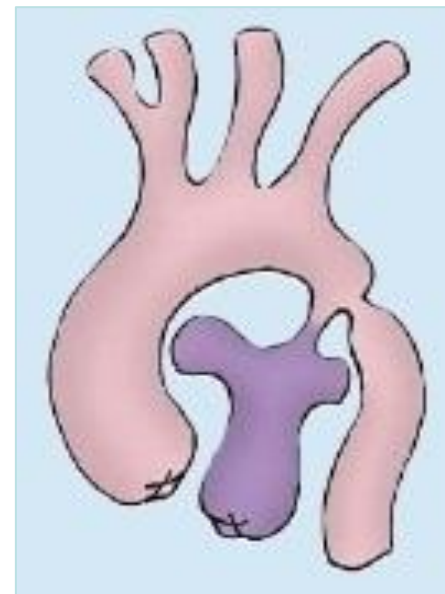
COARTAZIONE AORTICA non trattata



Pre-duttale



Para-duttale

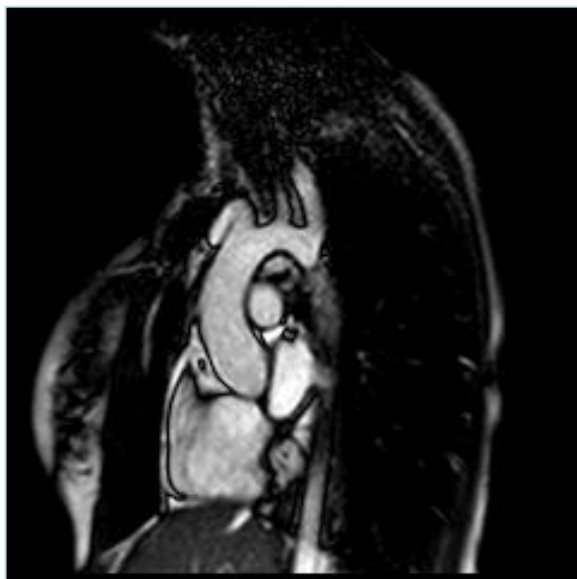


Post-duttale



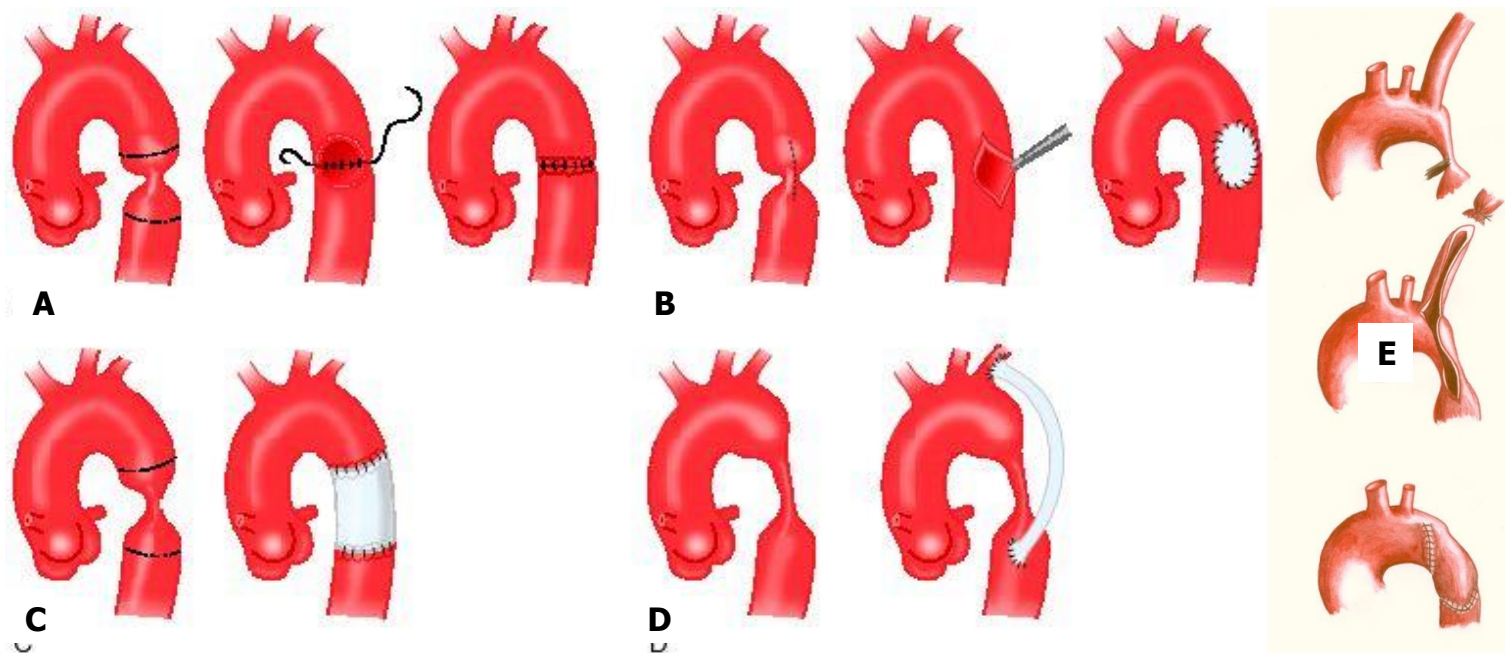
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COARTAZIONE AORTICA non trattata



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

COARTAZIONE AORTICA



**A. End to end anastomosis; B. Patch aortoplasty ; C. Tube interposition;
D. Subclavian to aortic by pass; E. Subclavian flap**



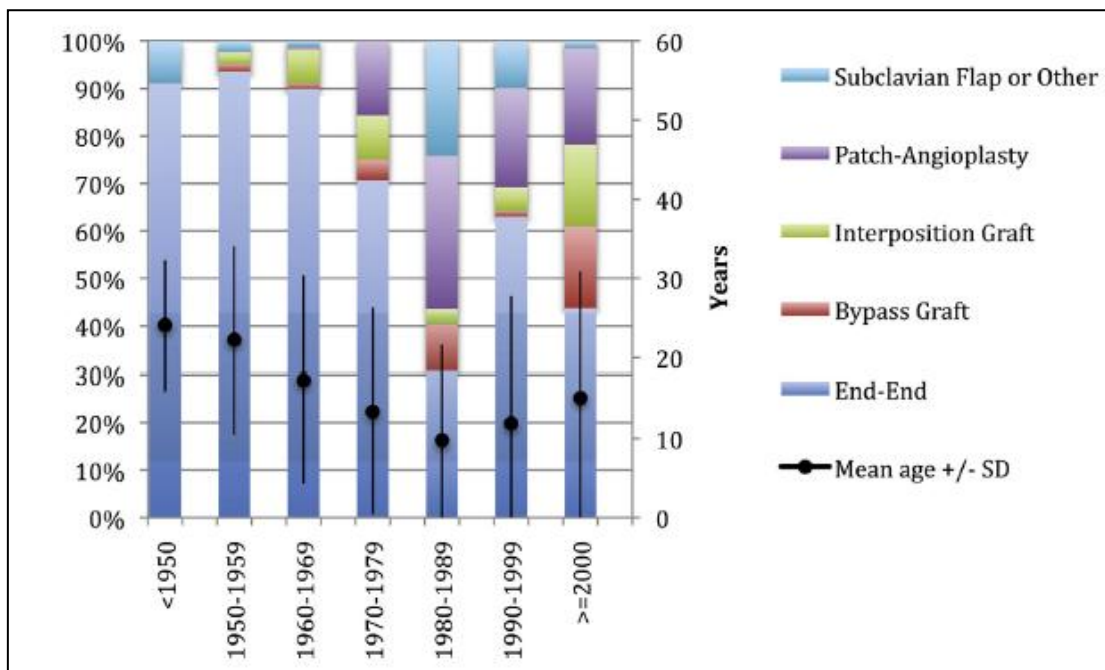
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Coarctation of the Aorta

Lifelong Surveillance Is Mandatory Following Surgical Repair

Table 1 Pre-Operative Characteristics (N = 819)

Characteristic	Value
Age at operation	
Mean $\pm$ SD, yrs	17.2 $\pm$ 13.6
Range	1 day to 72.2 yrs
Age group	
≤ 1 yr	116
>1 - ≤ 5 yrs	76
>5 - ≤ 10 yrs	123
>10 - ≤ 20 yrs	235
>20 yrs	269
Female	243 (30)
Pre-operation hypertension	683 (83)
NYHA class III or IV	32 (5)



1946 -> 2005
819 pts
Isolated CoA

Mayo Clinic



(J Am Coll Cardiol 2013;62:1020-5)

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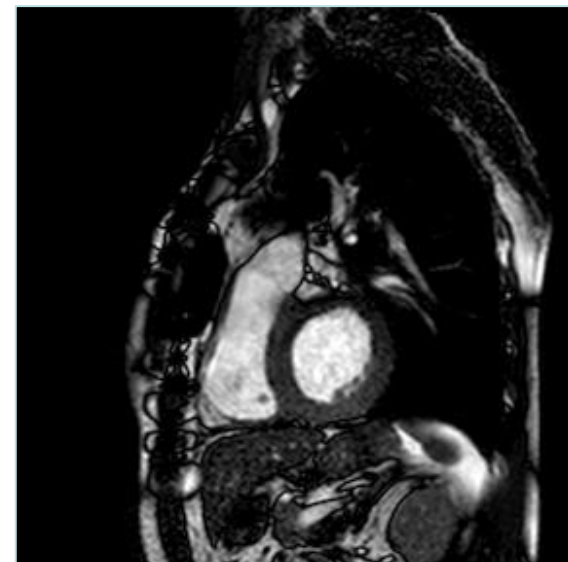
Heart

Survivors of coarctation repair: fixed but not cured

D S Celermajer and K Greaves

Heart 2002 88: 113-114

doi: 10.1136/heart.88.2.113



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Predictors of Aneurysmal Formation After Surgical Correction of Aortic Coarctation

Yskert von Kodolitsch, MD,* Muhammet A. Aydin, MD,* Dietmar H. Koschyk, MD,* Roger Loose, MD,§ Ilka Schalwat, MD,* Matthias Karck, MD,‡ Jochen Cremer, MD,§ Axel Haverich, MD,‡ Jürgen Berger, PhD,† Thomas Meinertz, MD,* Christoph A. Nienaber, MD, FACC*

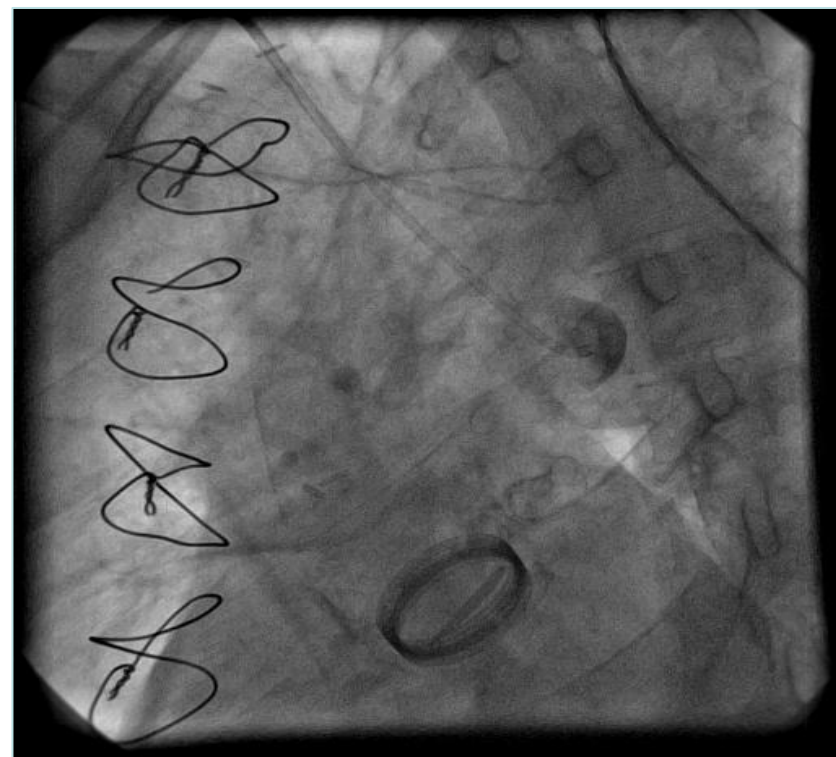
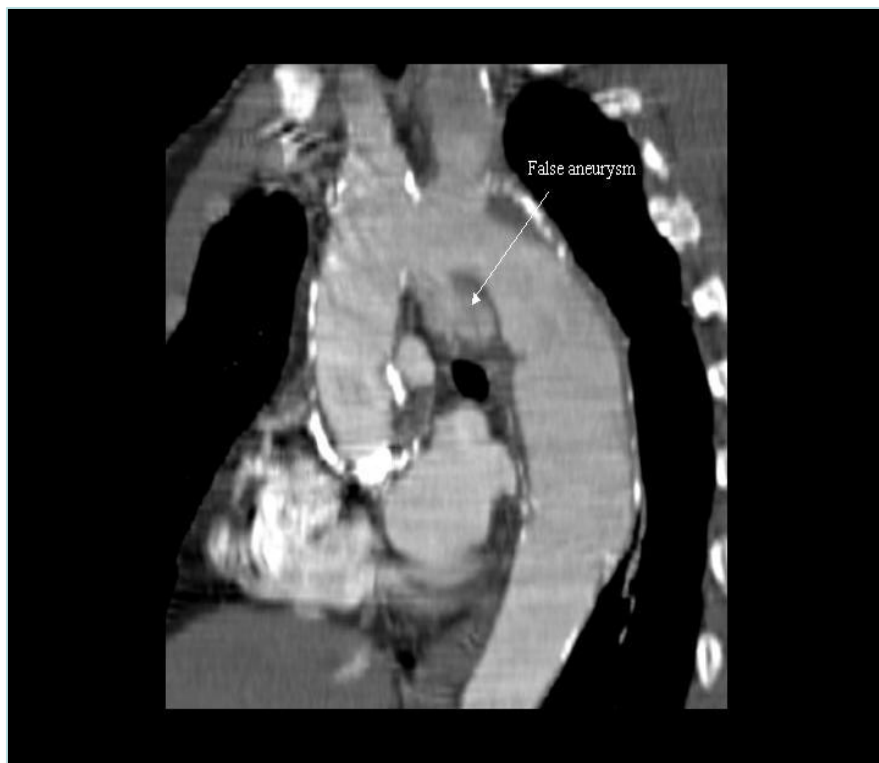
require early identification. A postsurgical aneurysm was observed with subclavian flap angioplasty (17%), patch angioplasty (14%), tube graft repair (6%) or end-to-end anastomosis (3%) (1–15), often associated with persistent systemic hypertension, concomitant cardiovascular malformations or use of Dacron and/or silk sutures (6–9,11), and presented as false, true or dissecting at various sites of the thoracic aorta (3,8,9). With this wide scope of potential risk

CONCLUSIONS

operation at a younger age.

Use of the patch graft technique and late correction of coarctation can predict aneurysmal formation at the site of coarctation repair, whereas patients with a bicuspid aortic valve may be at risk for an aneurysm developing in the ascending aorta, particularly after late repair of aortic coarctation with high preoperative pressure gradients. (J Am Coll Cardiol 2002;39: 617–24) © 2002 by the American College of Cardiology

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Faganello et al. EHJ 2008



Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Results of Screening for Intracranial Aneurysms in Patients with Coarctation of the Aorta

AJNR 33 | Jun-Jul 2012

117 CoA pts

12 pts (10.3%) -> aneurismi cerebrali

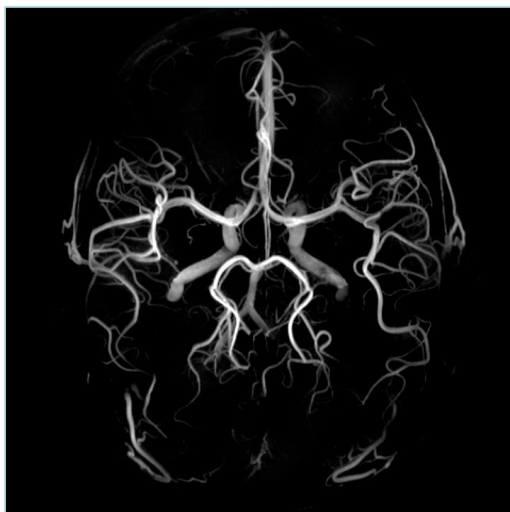


Table 3: Comparison of the aneurysm and no aneurysm groups

	Aneurysm (n = 12)	No Aneurysm (n = 105)	P Value
Age (yr) ^a	37 (16–50)	23 (16–59)	.04
Hypertension	83%	43%	.01
Smoker	25%	16%	.43
BAV or ascending aortopathy	42%	58%	.36
Aortic aneurysm	17%	10%	.36
SBP (mm Hg) ^a	138 ± 12	133 ± 17	.34
DBP (mm Hg) ^a	78 ± 10	74 ± 10	.22

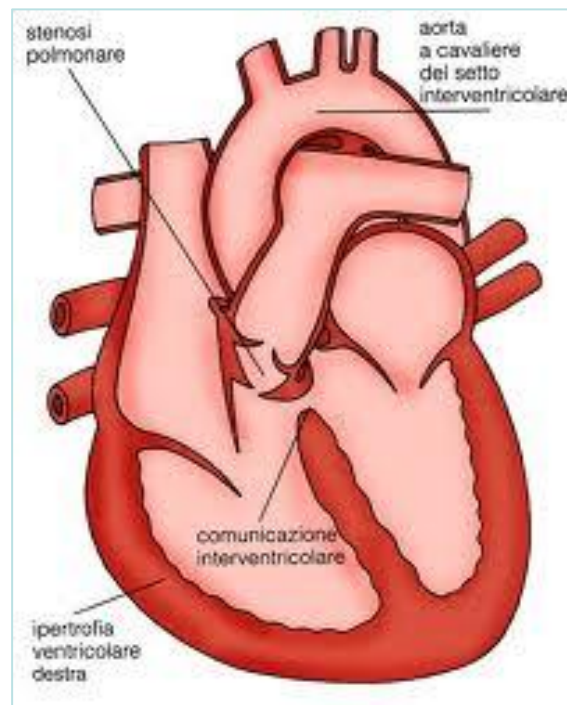
Table 2: Details of aneurysms and patient demographics

Site of Aneurysm	Size of Aneurysm (mm)	Sex	Age (yr)
Right MCA	4	F	38
Right PcomA	4	F	29
Right SCA	4	M	18
Left MCA	5	F	40
Left ACA	4	M	47
Right SCA	2	M	16
Left PcomA	4	M	41
Left MCA trunk	3	M	22
Left MCA trunk	3	M	24
Basilar termination	8	F	50
Right ICA bifurcation	3	M	35



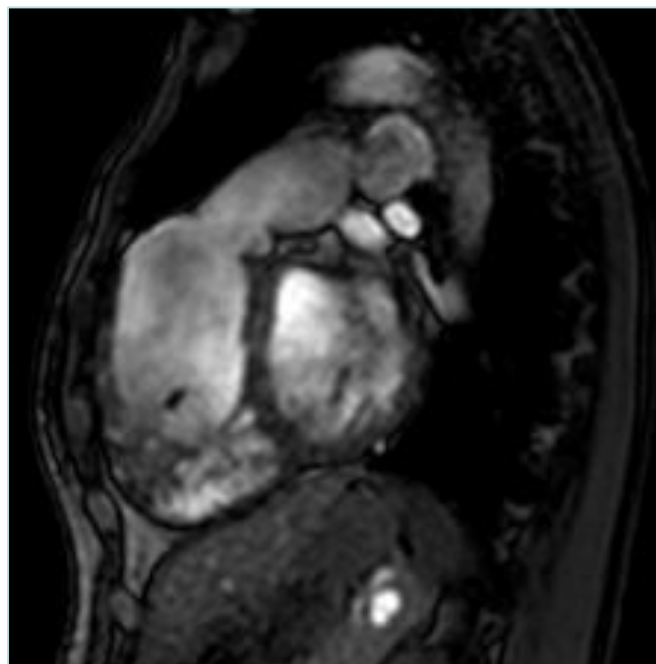
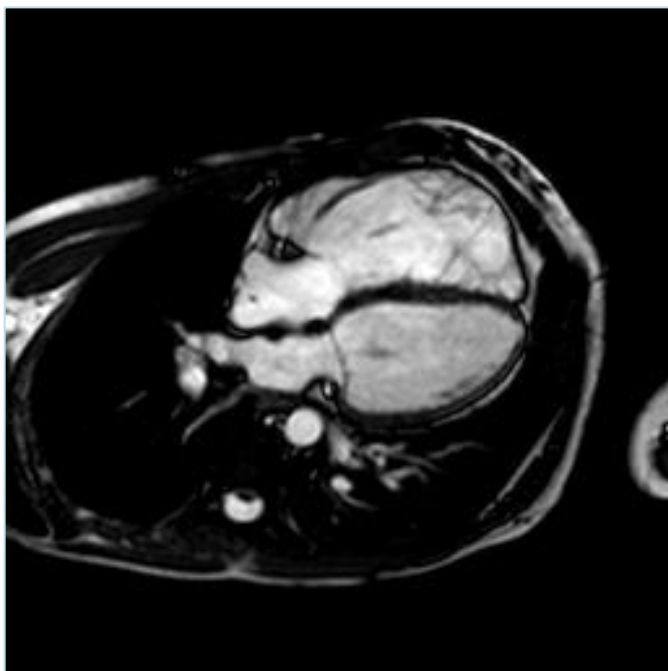
Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

TETRALOGIA DI FALLOT

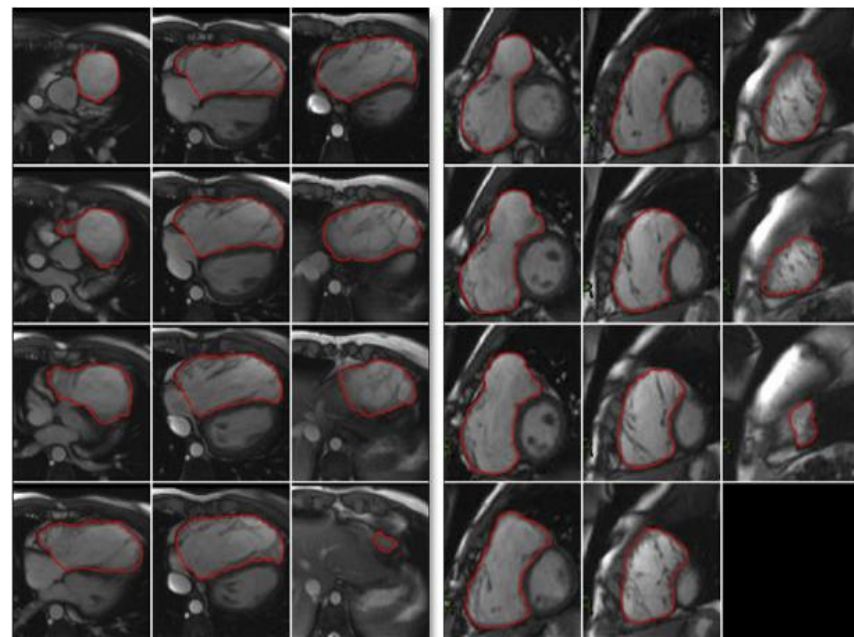
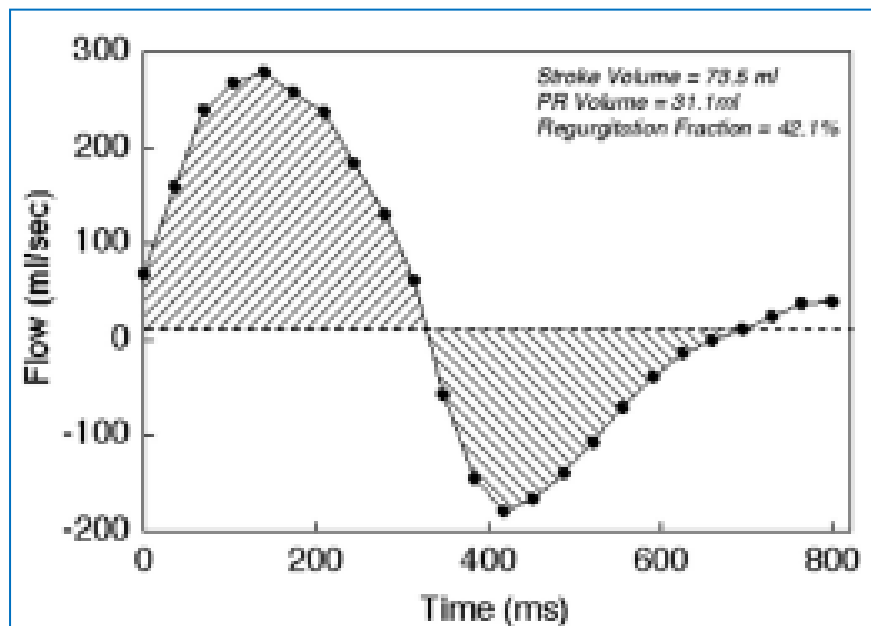


Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

TETRALOGIA DI FALLOT



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MRI – FUNZIONE
VENTRICOLARE E
FLUSSIMETRICA



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Geva *Journal of Cardiovascular Magnetic Resonance* 2011, 13:9
<http://www.jcmr-online.com/content/13/1/9>

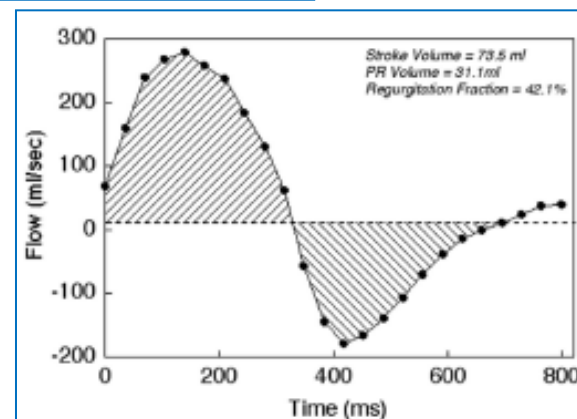
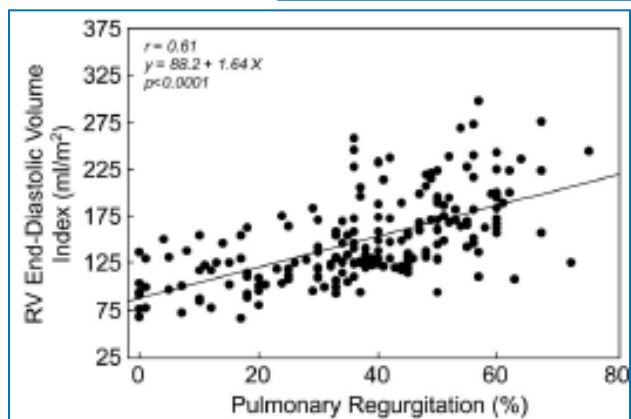


**Journal of Cardiovascular
Magnetic Resonance**

REVIEW

Open Access

Repaired tetralogy of Fallot: the roles of cardiovascular magnetic resonance in evaluating pathophysiology and for pulmonary valve replacement decision support



$$150\text{ml/m}^2 < \text{EDRVi} < 170\text{ml/m}^2$$



Geva, *Journal of Cardiovascular Magnetic Resonance* 2011

Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Ventricular size and function assessed by cardiac MRI predict major adverse clinical outcomes late after tetralogy of Fallot repair

A L Knauth,^{1,2} K Gauvreau,¹ A J Powell,¹ M J Landzberg,^{1,2} E P Walsh,¹ J E Lock,¹ P J del Nido,³ T Geva¹

Heart 2008;94:211–216.

88 TOF

Età media alla riparazione: 3 yrs

FuP 4.2 yrs

Outcomes:

morte, TVNS, incremento classe funzionale a NYHA III-IV

Eventi maggiori: 18 pts (20.5%)

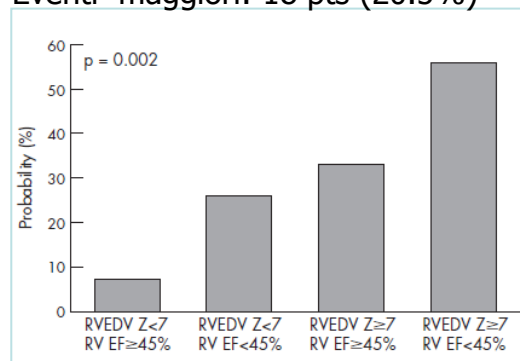


Table 2 Predictors of major adverse outcomes

Predictors	Odds ratio (95% CI)	Area under ROC curve	p Value
<i>Univariate analysis (controlling for time from baseline evaluation to most recent follow-up)</i>			
Age at TOF repair ≥ 6 years	7.78 (2.26 to 26.7)	0.748	0.001
Era of repair before 1970	4.05 (1.11 to 14.8)	0.591	0.035
RV end-diastolic volume Z ≥ 7	4.98 (1.47 to 16.9)	0.688	0.01
RV end-systolic volume index > 50 ml/m ²	5.82 (1.22 to 27.7)	0.708	0.027
RV ejection fraction < 45%	5.31 (1.59 to 17.8)	0.750	0.007
LV ejection fraction < 55%	7.13 (2.11 to 24.0)	0.760	0.002
LV mass/volume ratio > 1.5	4.56 (1.27 to 16.4)	0.688	0.02
QRS ≥ 180 ms	6.27 (1.86 to 21.1)	0.673	0.003
Diuretics at baseline evaluation	7.68 (2.03 to 29.1)	0.646	0.003
Digoxin at baseline evaluation	4.67 (1.30 to 16.8)	0.689	0.018
β-Blocker at baseline evaluation	6.88 (1.12 to 42.3)	0.654	0.037
NYHA class II or III at baseline evaluation	5.27 (1.55 to 17.9)	0.724	0.008
<i>Multivariate analysis (controlling for time from baseline evaluation to most recent follow-up)</i>			
Model 1			
LV ejection fraction < 55%	8.05 (2.14 to 30.2)		0.002
RV end-diastolic volume Z ≥ 7	4.55 (1.10 to 18.8)		0.037
Area under ROC curve for the model: 0.850			
Model 2			
RV ejection fraction < 45%	5.60 (1.47 to 21.2)		0.011
RV end-diastolic volume Z ≥ 7	4.00 (1.10 to 14.6)		0.036
Area under ROC curve for the model: 0.807			

CI, confidence interval; LV, left ventricular; ROC, receiver operator characteristic; RV, right ventricular; TOF tetralogy of Fallot.



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Journal of the American College of Cardiology
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Published by Elsevier Science Inc.

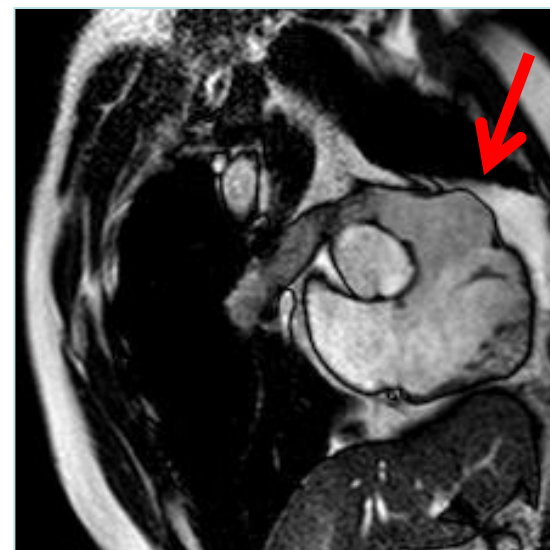
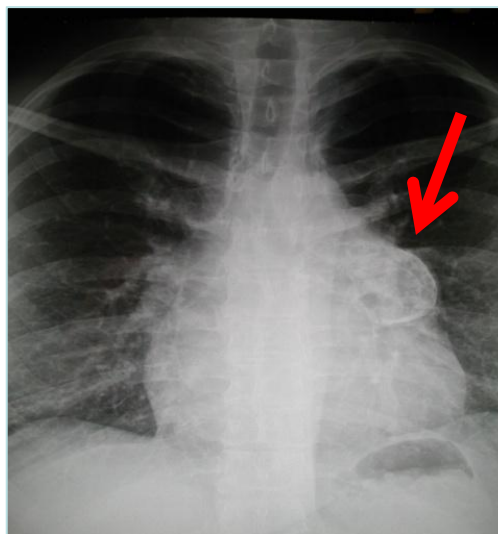
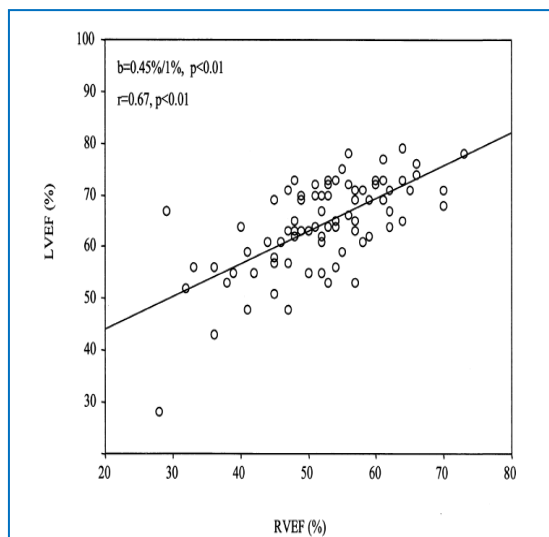
Vol. 40, No. 11, 2002
ISSN 0735-1097/02/\$22.00
PII S0735-1097(02)02566-4

Adult Congenital Disease

Right Ventricular Function in Adults With Repaired Tetralogy of Fallot Assessed With Cardiovascular Magnetic Resonance Imaging: Detrimental Role of Right Ventricular Outflow Aneurysms or Akinesia and Adverse Right-to-Left Ventricular Interaction

Periklis A. Davlouros, MD,* Philip J. Kilner, MD, PhD,† Tim S. Hornung, MD,* Wei Li, MD, PhD,* Jane M. Francis, DCR(R),† James C. C. Moon, MD,† Gillian C. Smith, BSE,† Tri Tat, PhD,‡ Dudley J. Pennell, MD, FACC,† Michael A. Gatzoulis, MD, PhD, FACC*
London, United Kingdom

RVOT

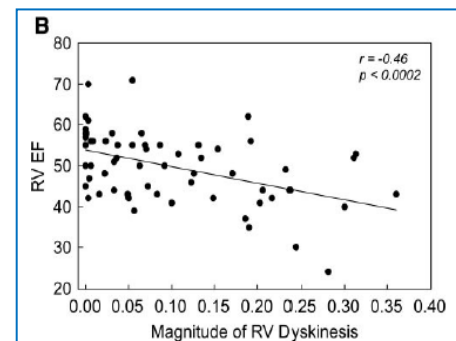
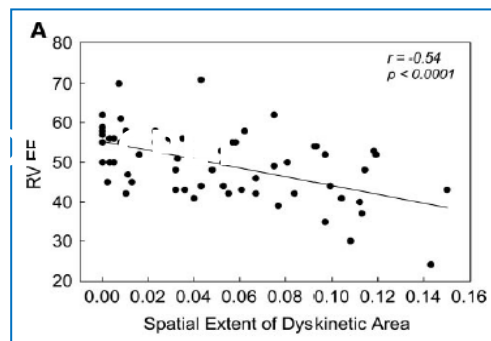
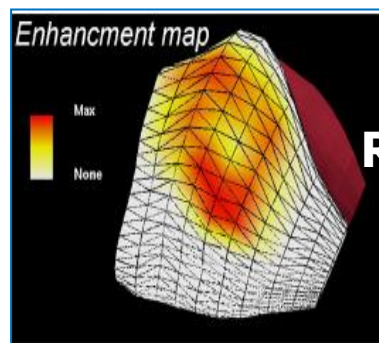
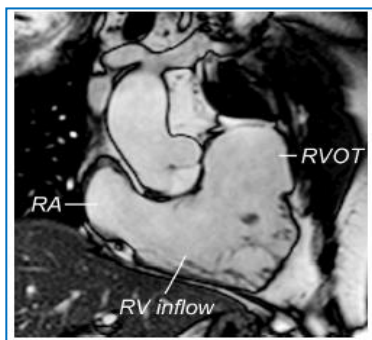


TOF vs controls. Presenza di **RVOT** aneurysm/akinesia è correlato a RVH, Dilatazione Vdx, ridotta RVEF

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Effects of Regional Dysfunction and Late Gadolinium Enhancement on Global Right Ventricular Function and Exercise Capacity in Patients With Repaired Tetralogy of Fallot

Rachel M. Wald, MD; Idith Haber, PhD; Ron Wald, MDCM, MPH; Anne Marie Valente, MD; Andrew J. Powell, MD; Tal Geva, MD

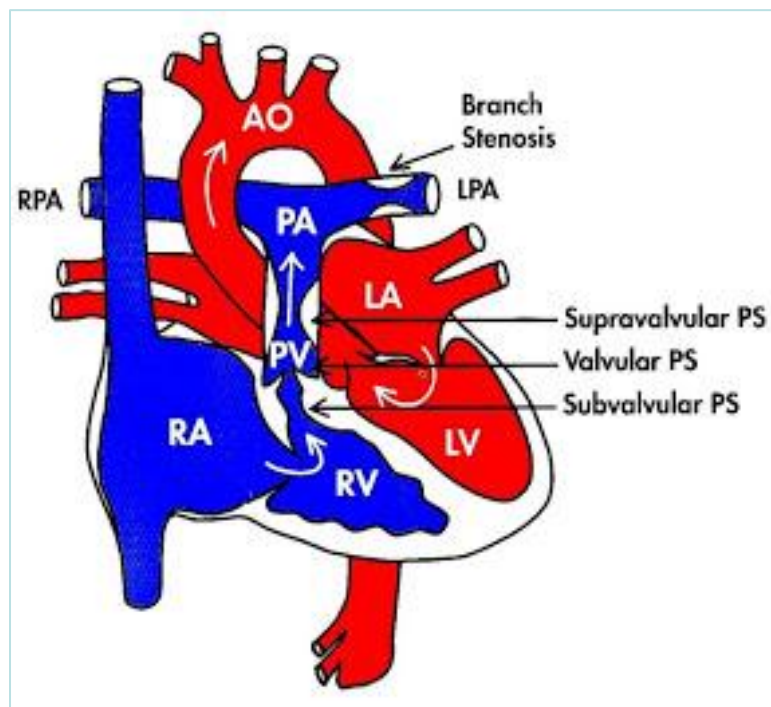


Conclusion—A greater extent of regional abnormalities in the RVOT adversely affects global RV function and exercise capacity after tetralogy of Fallot repair. These regional measures may have important implications for patient management, including RVOT reconstruction, at the time of pulmonary valve replacement. (*Circulation*. 2009;119:1370-1377.)



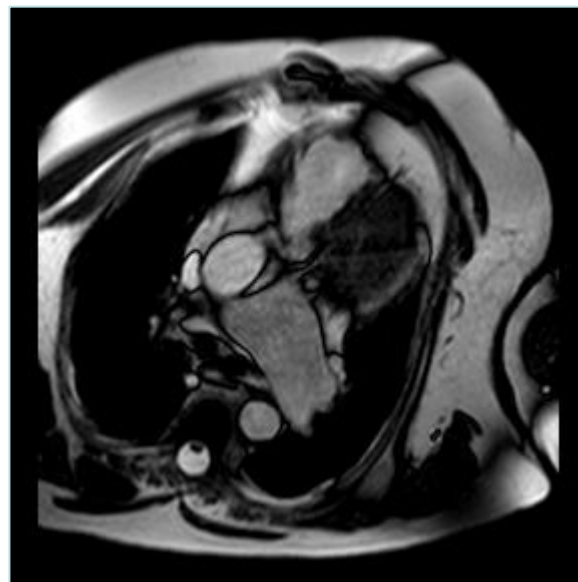
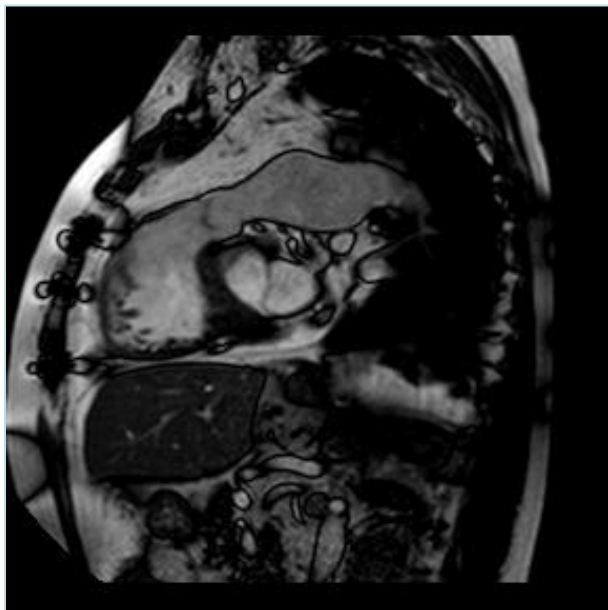
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STENOSI DELLA VALVOLA POLMONARE



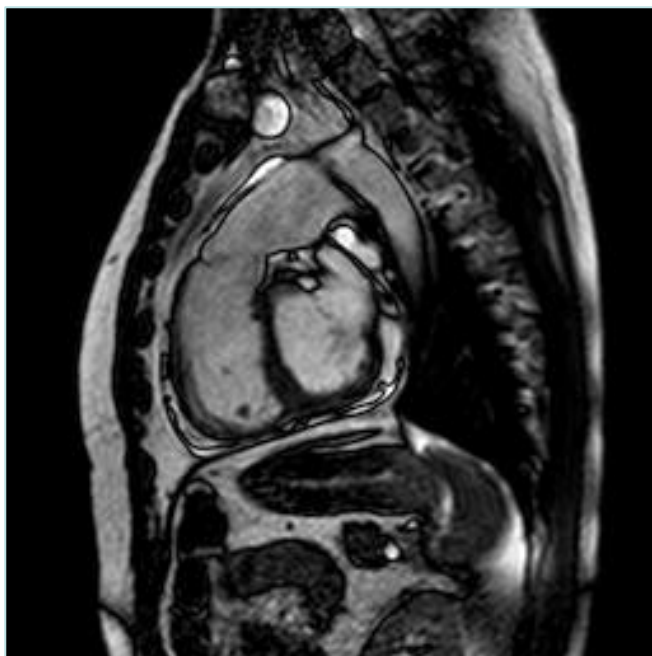
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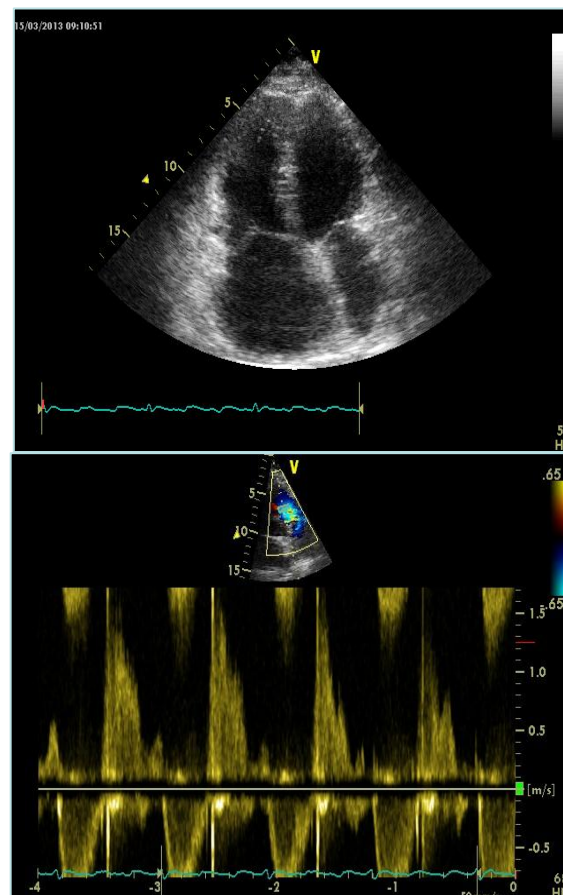


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STENOSI DELLA VALVOLA POLMONARE trattata

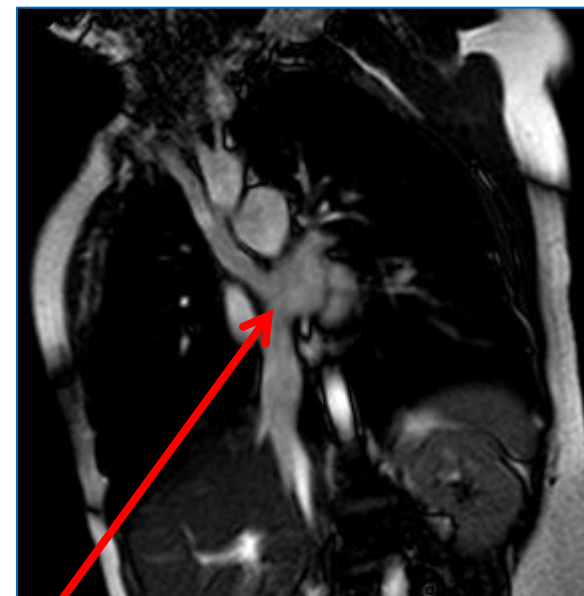
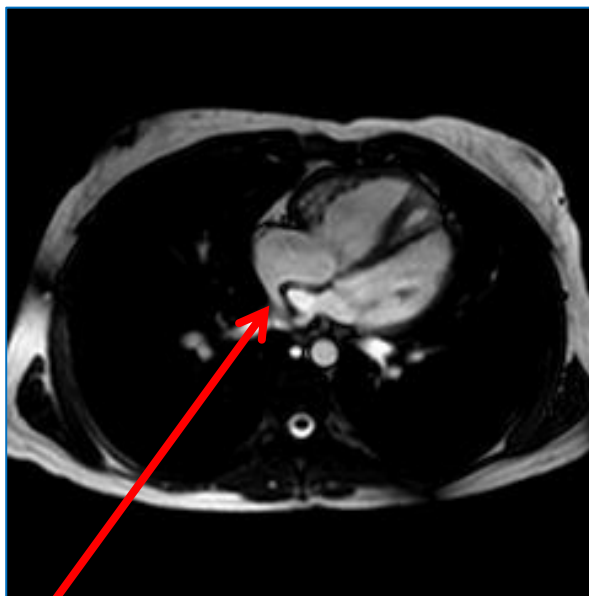
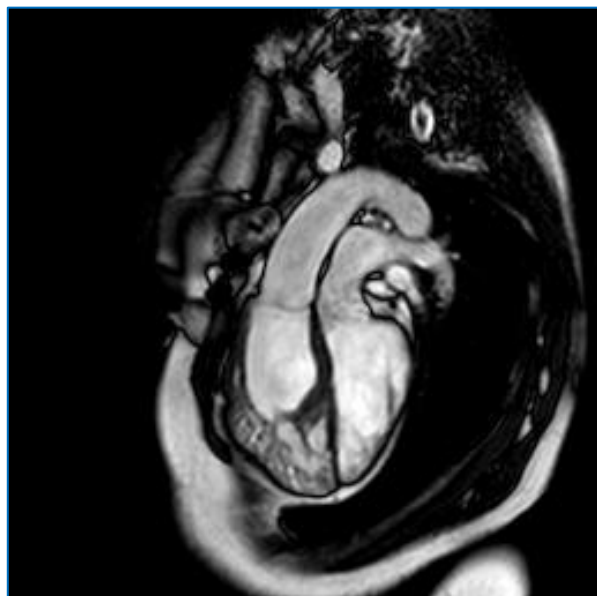


RV a fisiologia restrittiva



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TRASPOSIZIONE GRANDI VASI



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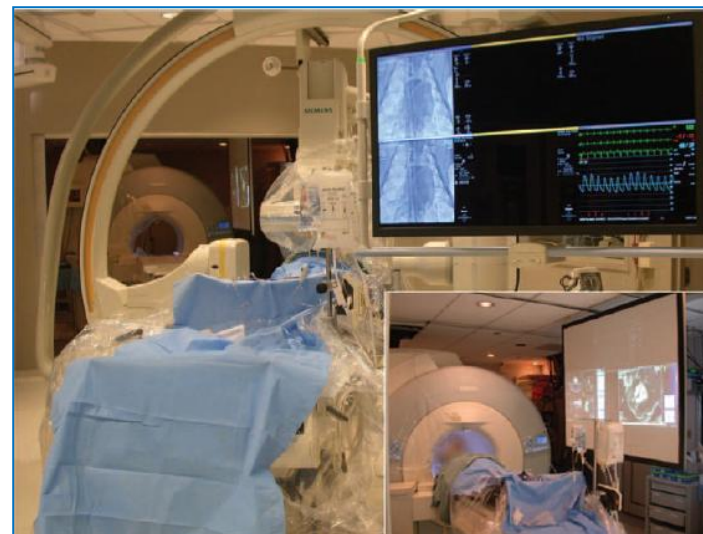
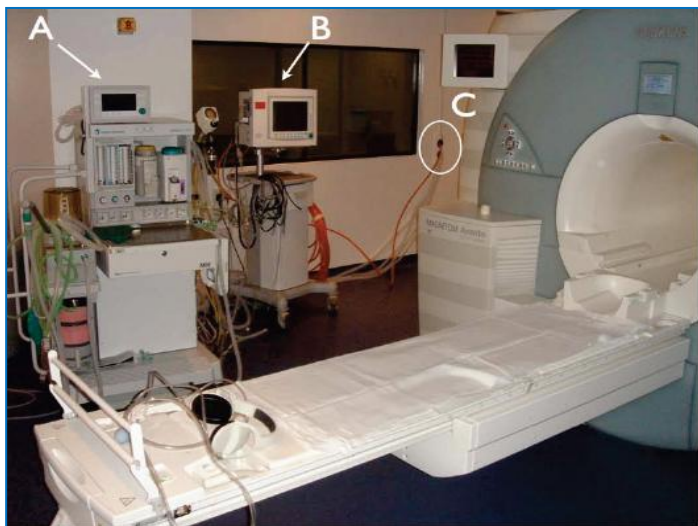


European Heart Journal
doi:10.1093/eurheartj/ehs189

CLINICAL RESEARCH

Real-time MRI-guided right heart catheterization in adults using passive catheters

EHJ 2012



Definizione anatomica + emodinamica
Evitare esposizione a radiazioni

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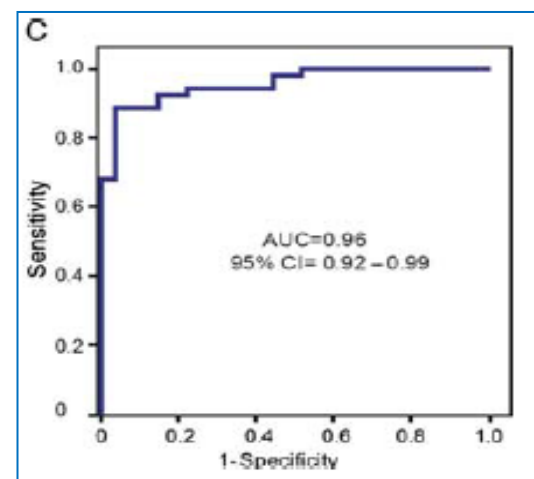
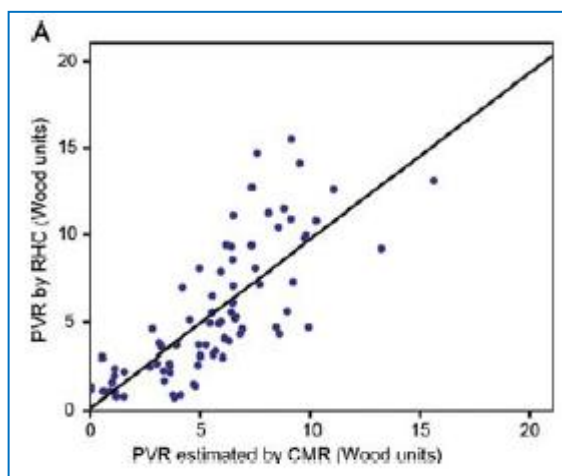
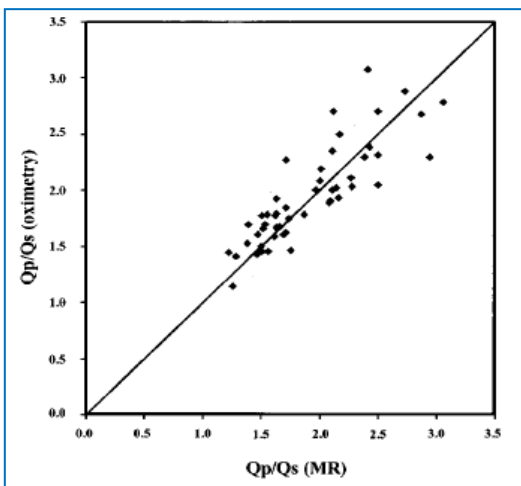
European Heart Journal (2011) 32, 2438–2445
doi:10.1093/eurheartj/ehrl73

CLINICAL RESEARCH

Imaging

Non-invasive estimation of pulmonary vascular resistance with cardiac magnetic resonance

Ana García-Alvarez^{1,2,3}, Leticia Fernández-Friera¹, Jesús G. Mirelis^{1,2}, Simonette Sawit¹, Ajith Nair¹, Jill Kallman¹, Valentin Fuster^{1,2}, and Javier Sanz^{1*}



$$\text{estimated PVR (in WU)} = 19.38 - [4.62 \times \ln \text{PA average velocity (in cm/s)}] - [0.08 \times \text{RVEF (in \%)}]$$



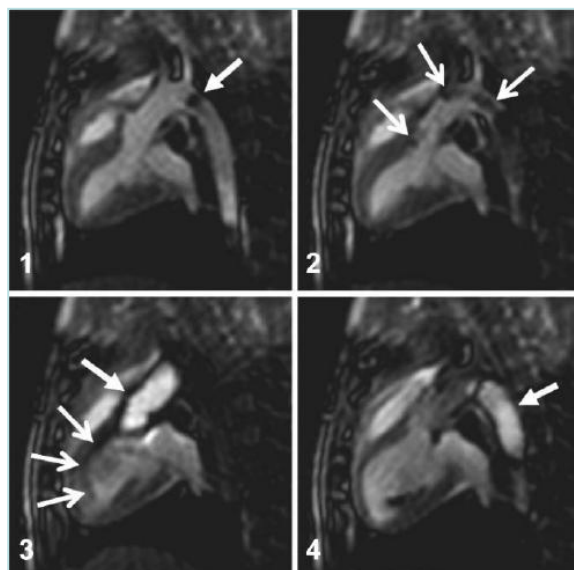
100 pts. CMR + Cateterismo dx. Ottima correlazione tra le due metodiche

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Magnetic Resonance–Guided Cardiac Interventions Using Magnetic Resonance–Compatible Devices

A Preclinical Study and First-in-Man Congenital Interventions

Circ Cardiovasc Interv. 2010;3:585-592



Conclusions—The described preclinical study and case reports are encouraging that with the availability of the new MR-compatible and safe guide wire, certain percutaneous cardiac interventions will become feasible to perform solely under MR guidance in the future. A clinical trial is underway in our institution. (*Circ Cardiovasc Interv.* 2010;3:585-592.)





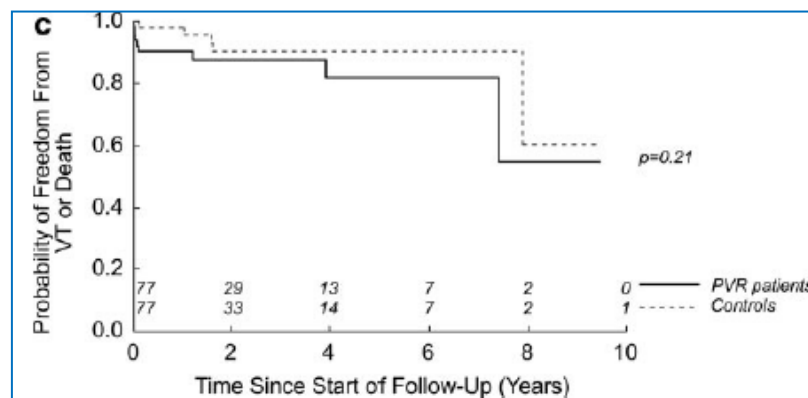
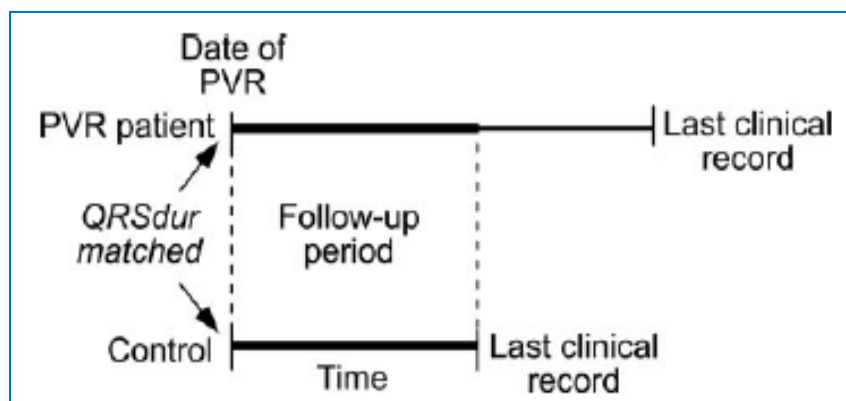
GRAZIE

Il ruolo della risonanza magnetica cardiaca nell'Ambulatorio GUCH

Pulmonary Valve Replacement in Tetralogy of Fallot Impact on Survival and Ventricular Tachycardia

David M. Harrild, MD, PhD; Charles I. Berul, MD; Frank Cecchin, MD; Tal Geva, MD;
Kimberlee Gauvreau, ScD; Frank Pigula, MD; Edward P. Walsh, MD

Circulation. 2009;119:445-451



LATE PVR -> RIDUZIONE DI 30-40% RVEDV/RVRSV;
MIGLIORA LVEDV; MIGLIORA TR; MIGLIORA NYHA
NON MIGLIORA SOPRAVVIVENZA, QRS DURATA, VT

Conclusions—This cohort experienced either VT or death every 20 patient-years. In a matched comparison with a similar TOF group, late PVR for symptomatic pulmonary regurgitation/RV dilation did not reduce the incidence of VT or death.

