



Mild to late onset Right Ventricular dysfunction in LVAD

From mechanism to management

Pr Guinot Pierre-Grégoire

CHU de Dijon

[@GuinotPg](#)





Abbott



Abbott

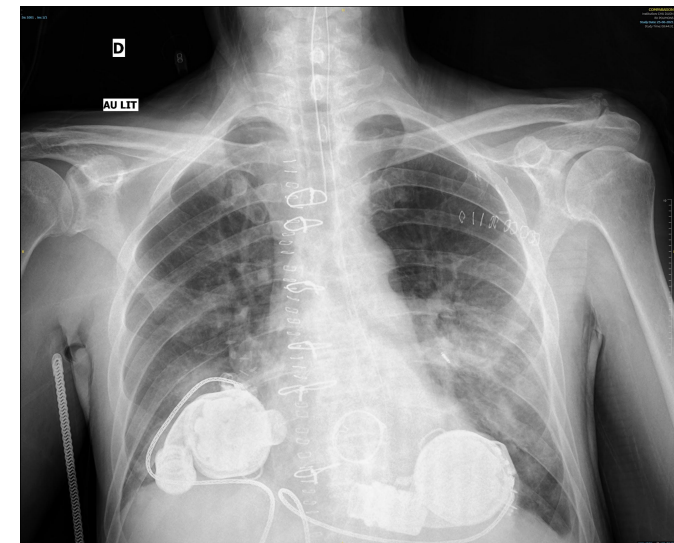
Conflicts of interest

60 years old man with valvular and rythmic cardiomyopathy

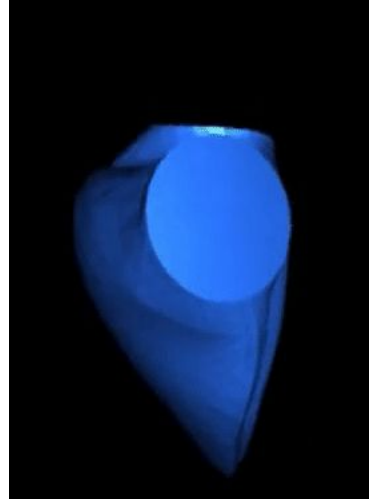
HM3 support as bridge to HTX
 Simple post operative course but...



	M1-2	M3	M4	M5	M6
Echography	RV (35-40) Dilatation of IVC (2 cm) but collapsibility +	RV(46-48) IVC dilated (2.4 cm)	RV (50-55) IVC dilated (2.7 cm)	RV dilatation, paradoxal septum, annular dilattaion with laminar TI,	RV dilatation, paradoxal septum, annular dilattaion with laminar TI, and IVC (3cm)
Cardiomems (MPAP, mmHg)	23-26	23-26	25-28	25-30	29-30
Clinique	No pleural effusion, no limb oedema	No pleural effusion, no limb oedema		Pleural effusion, lower limb oedema	
Biologie			↑ Creat, cholestase	↑ Creat, ↑ bili	↑Creat ↑ bili



Introduction



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right ventricular failure lvad

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RESULTS BY YEAR



16 results

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Right Ventricular Failure Post-Implantation of Left Ventricular Assist Device: Prevalence, Pathophysiology, and Predictors.

1

Cite

Ali HR, Kiernan MS, Choudhary G, Levine DJ, Sodha NR, Ehsan A, Yousefzai R.

ASAIO J. 2020 Jun;66(6):610-619. doi: 10.1097/MAT.0000000000001088.

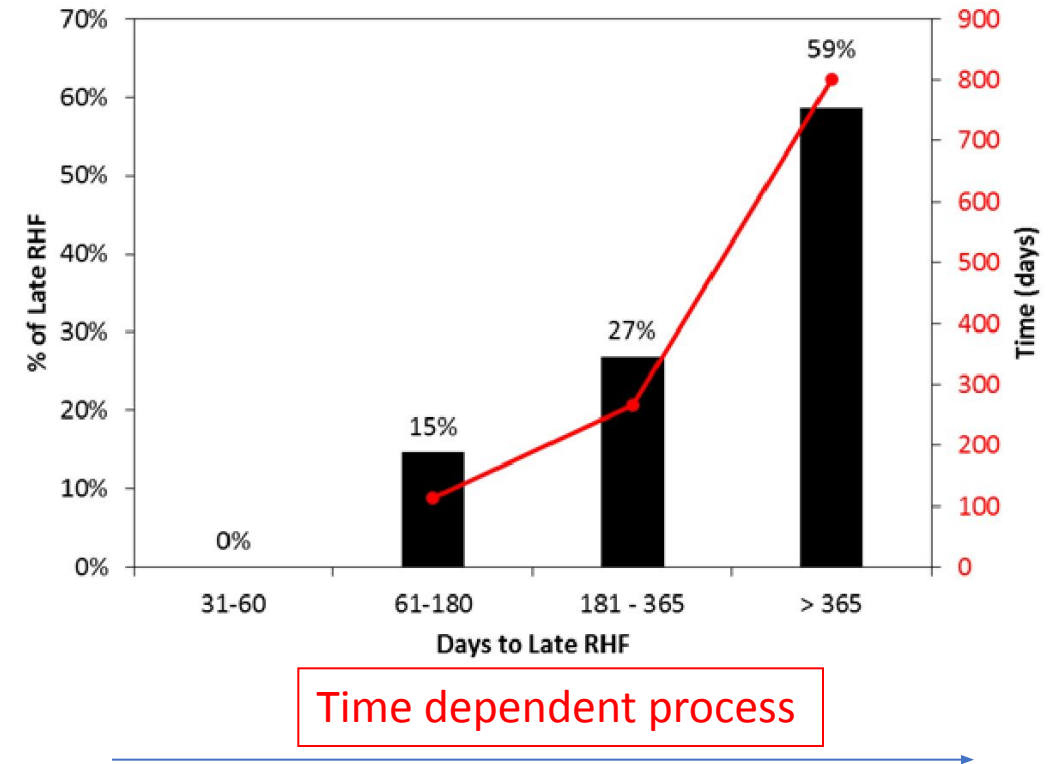
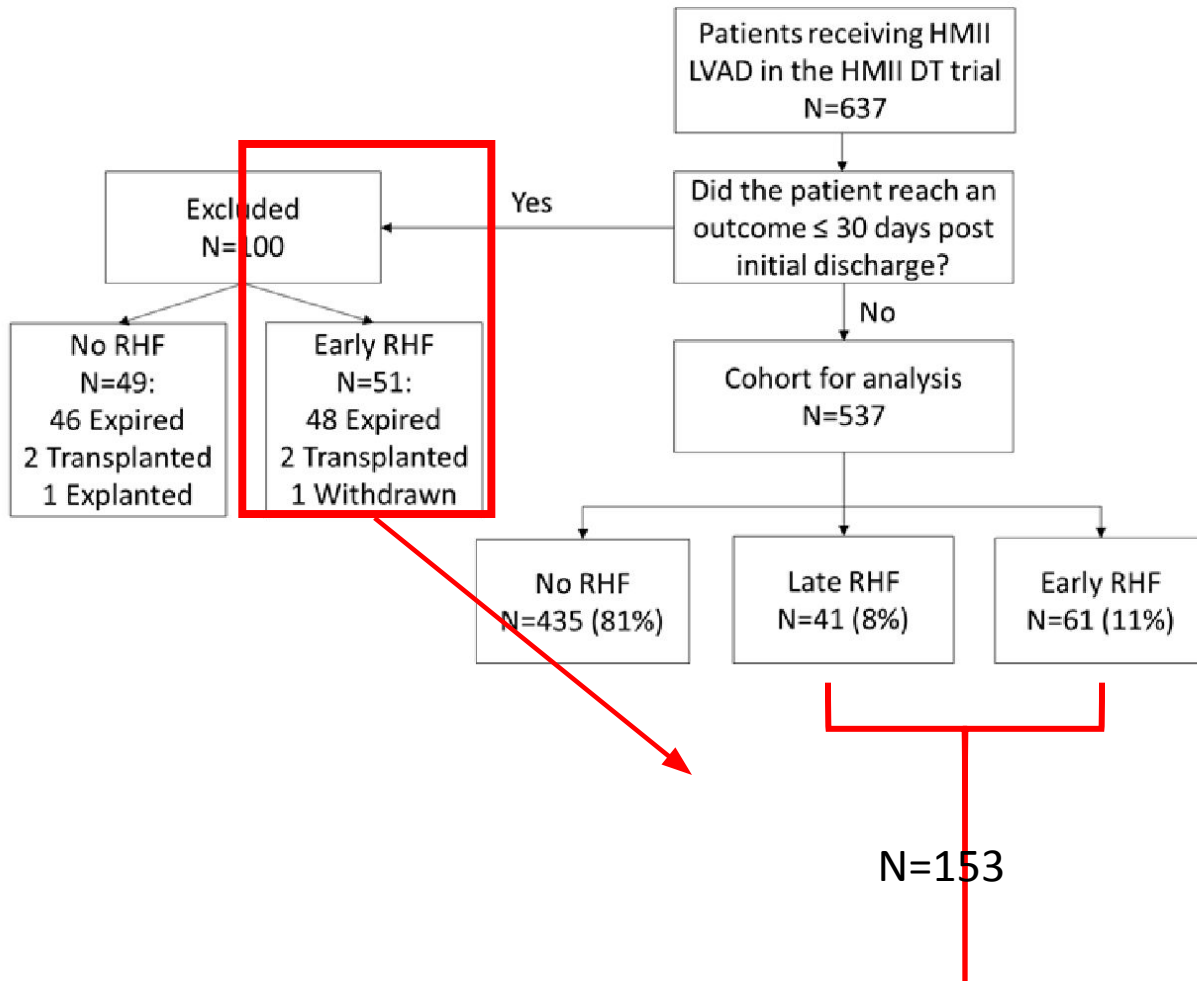
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PMID: 31651460 [Review](#).

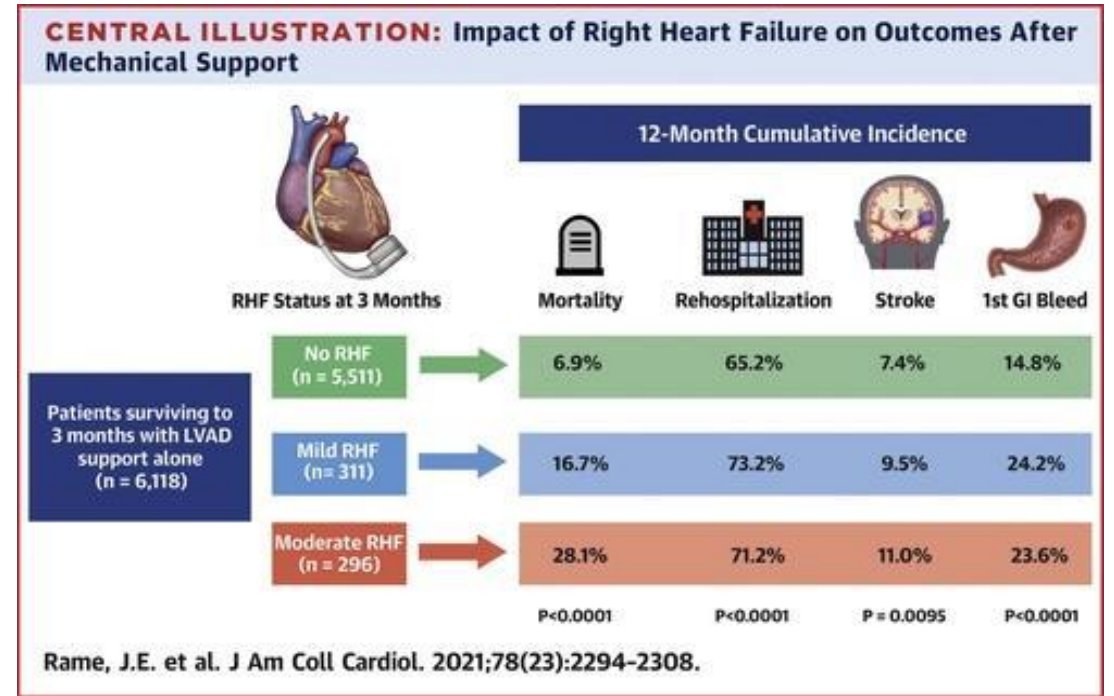
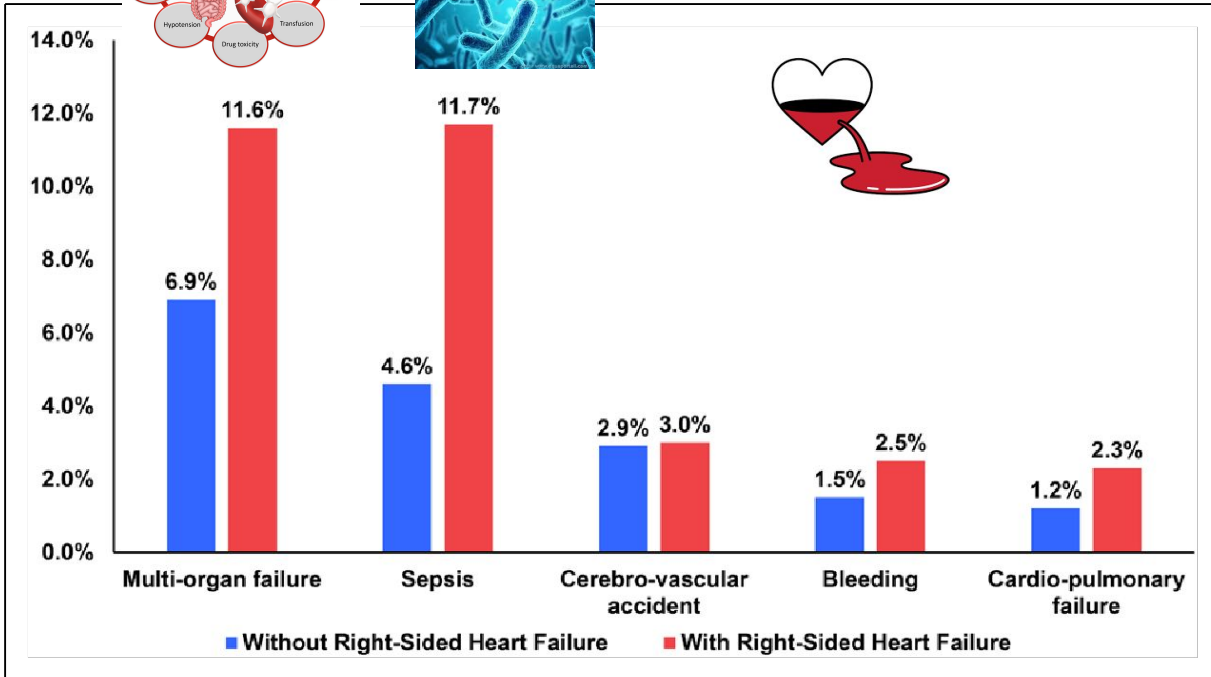
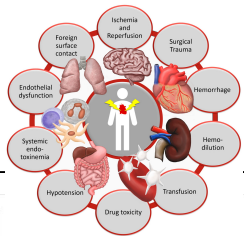
Despite advances in left **ventricular** assist device (**LVAD**) technology, **right ventricular failure** (**RVF**) continues to be a complication after implantation. Most patients undergoing **LVAD** implantation have underlying **right ventricula ...**

Why are we talking about mild-late RV dysfunction?

RV dysfunction and LVAD: up to 25% of patients will have RVD but only 10% have late onset-RV dysfunction



Late onset RVD is associated to morbidity and mortality

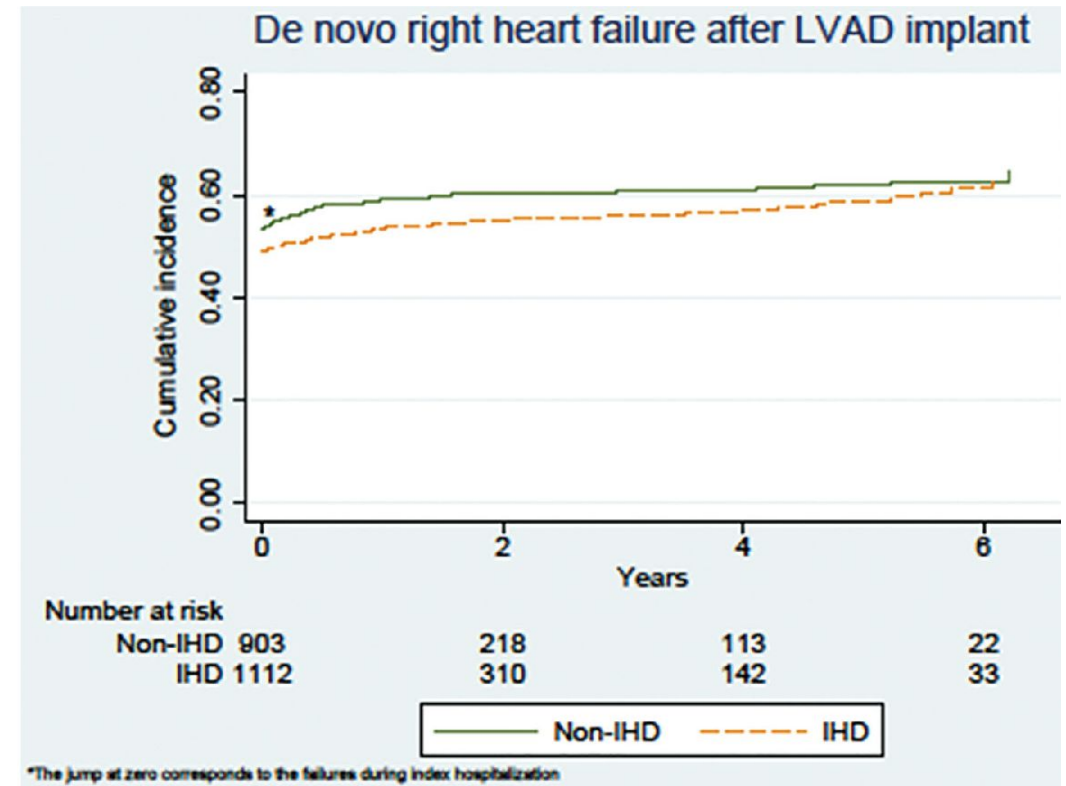
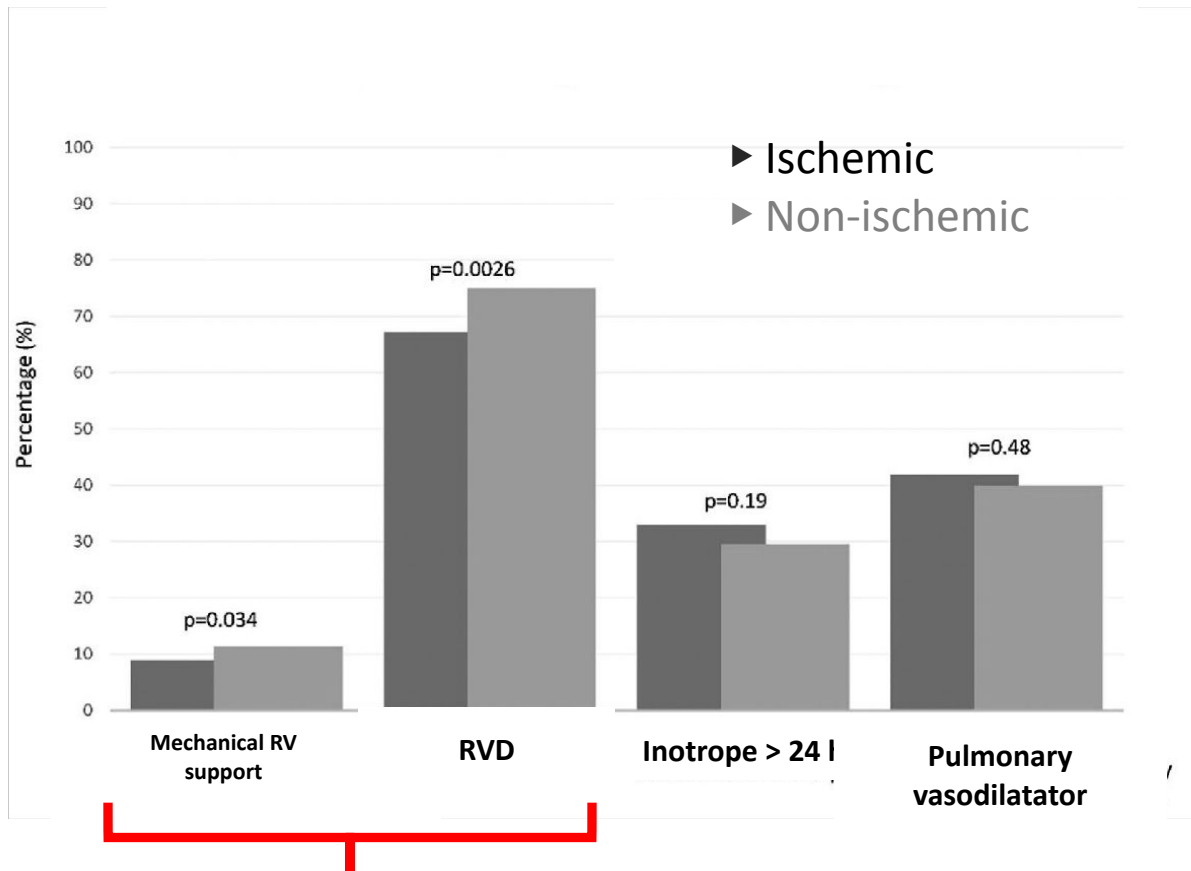


Risk factors of late onset-RVD

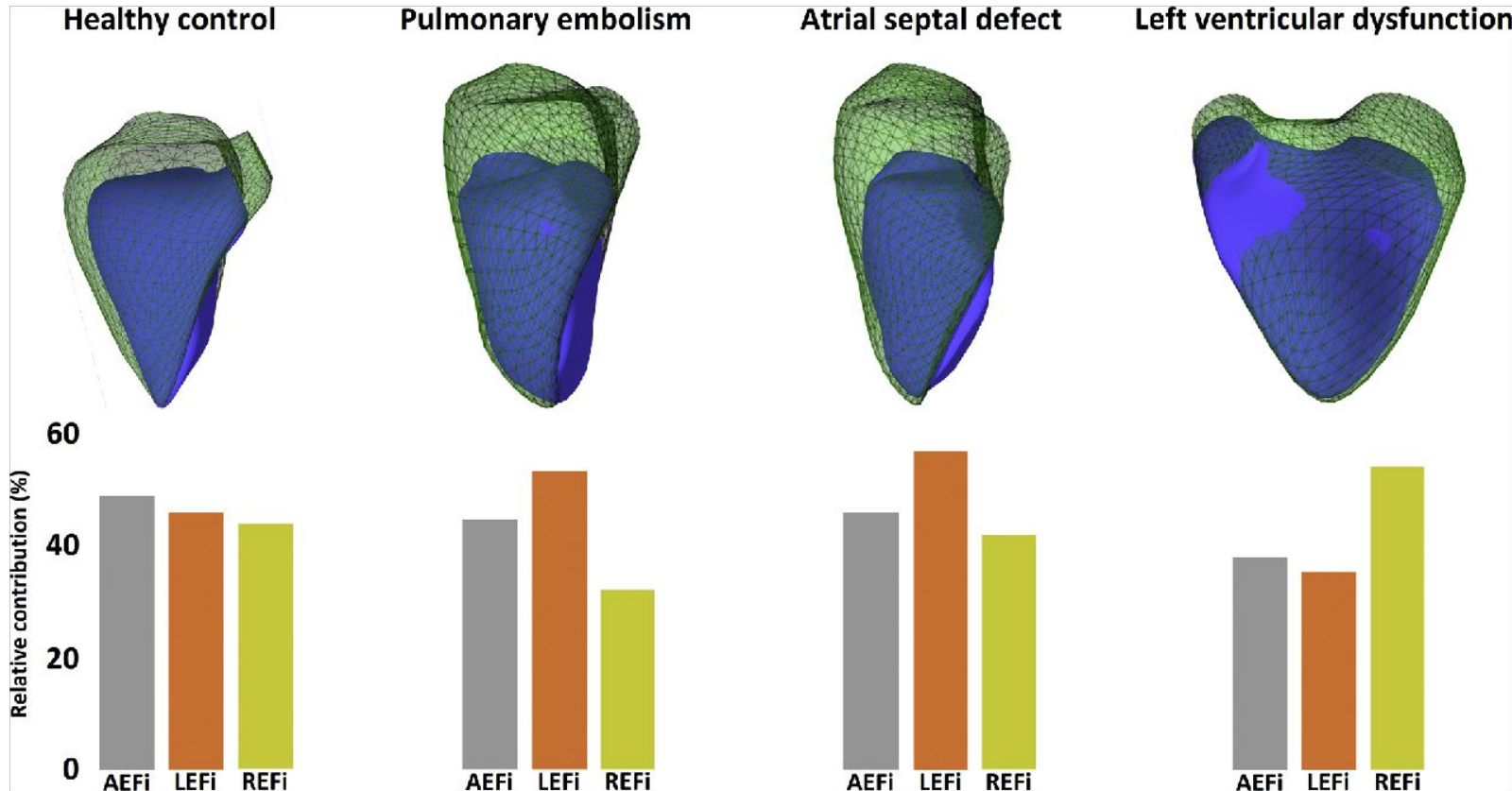
Get back to physiology

The cause of the heart disease: Ischemic > non-ischemic

Retrospective cohort EUROMACS 2011-18, 3536 patients

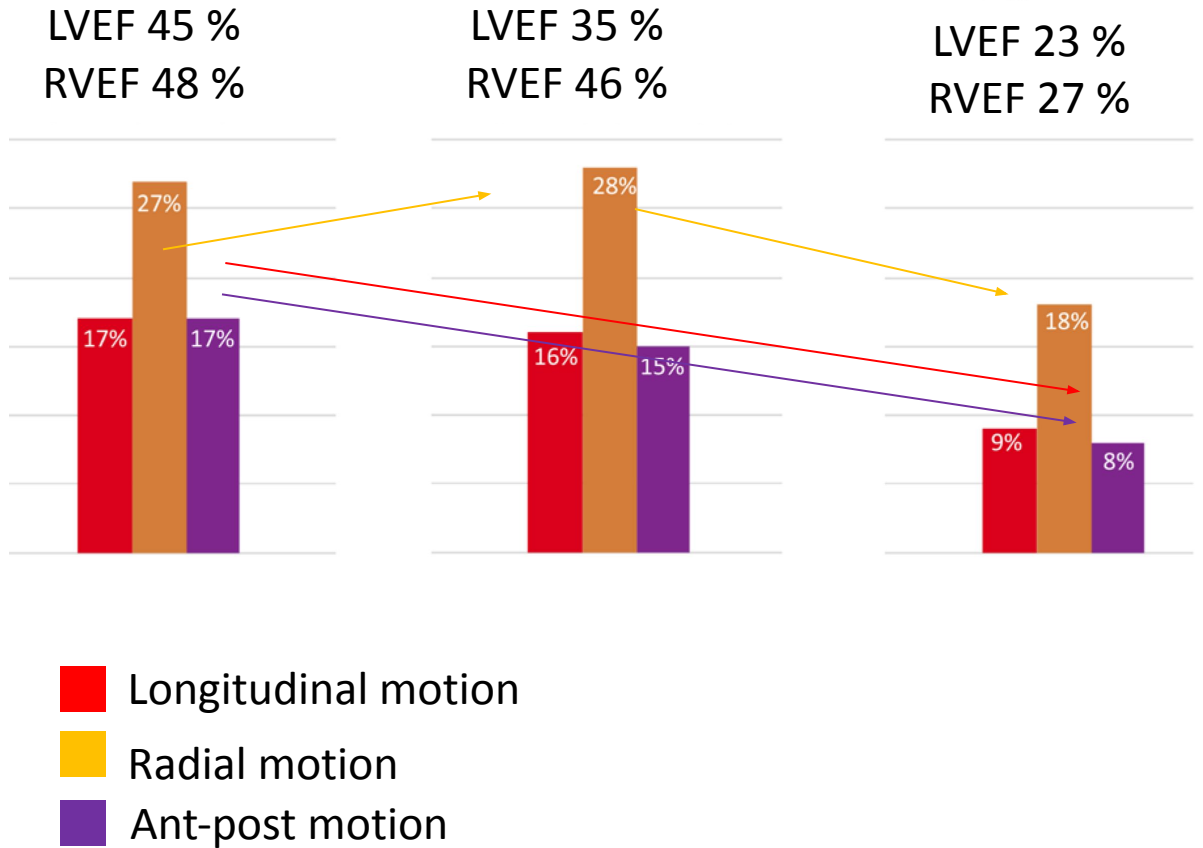
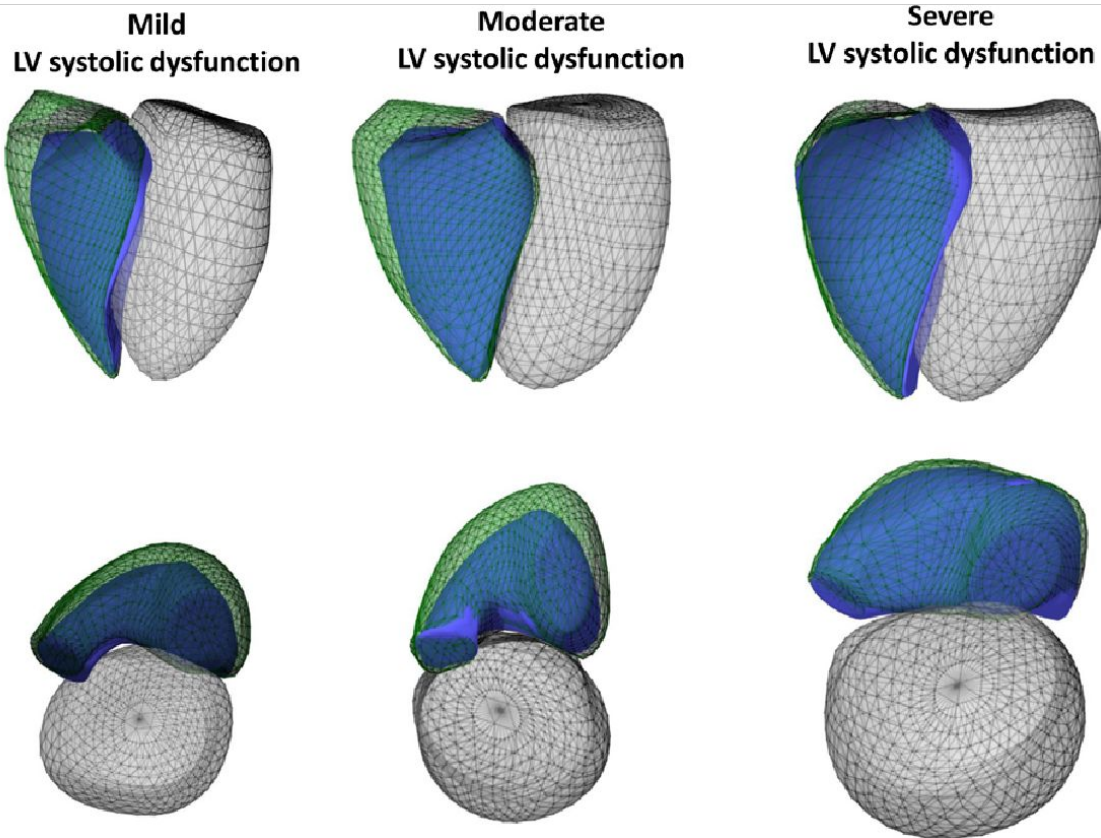


The underlying cause affects the right ventricle morphology/function

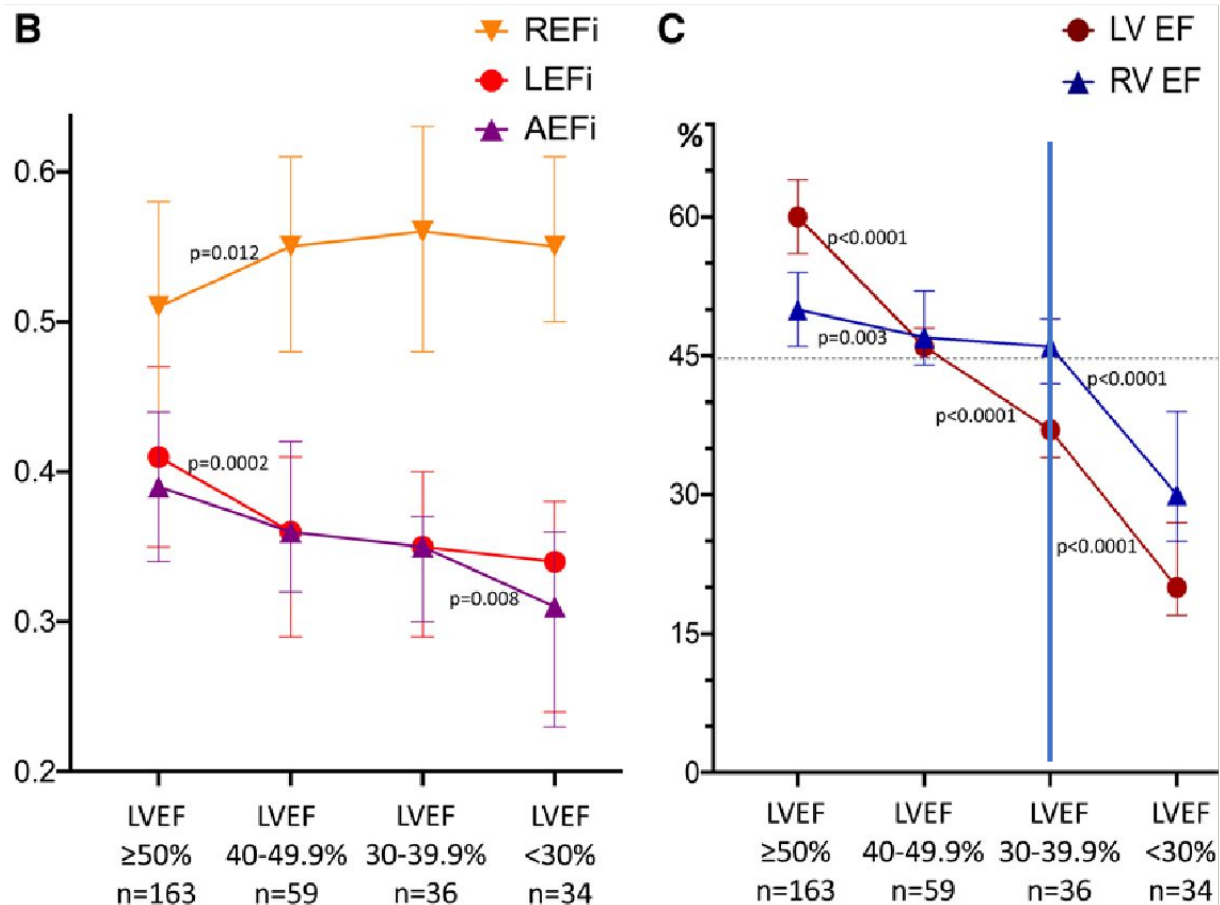


- Longitudinal motion
- Radial motion
- Ant-post motion

The underlying cause affects the right ventricle morphology/function



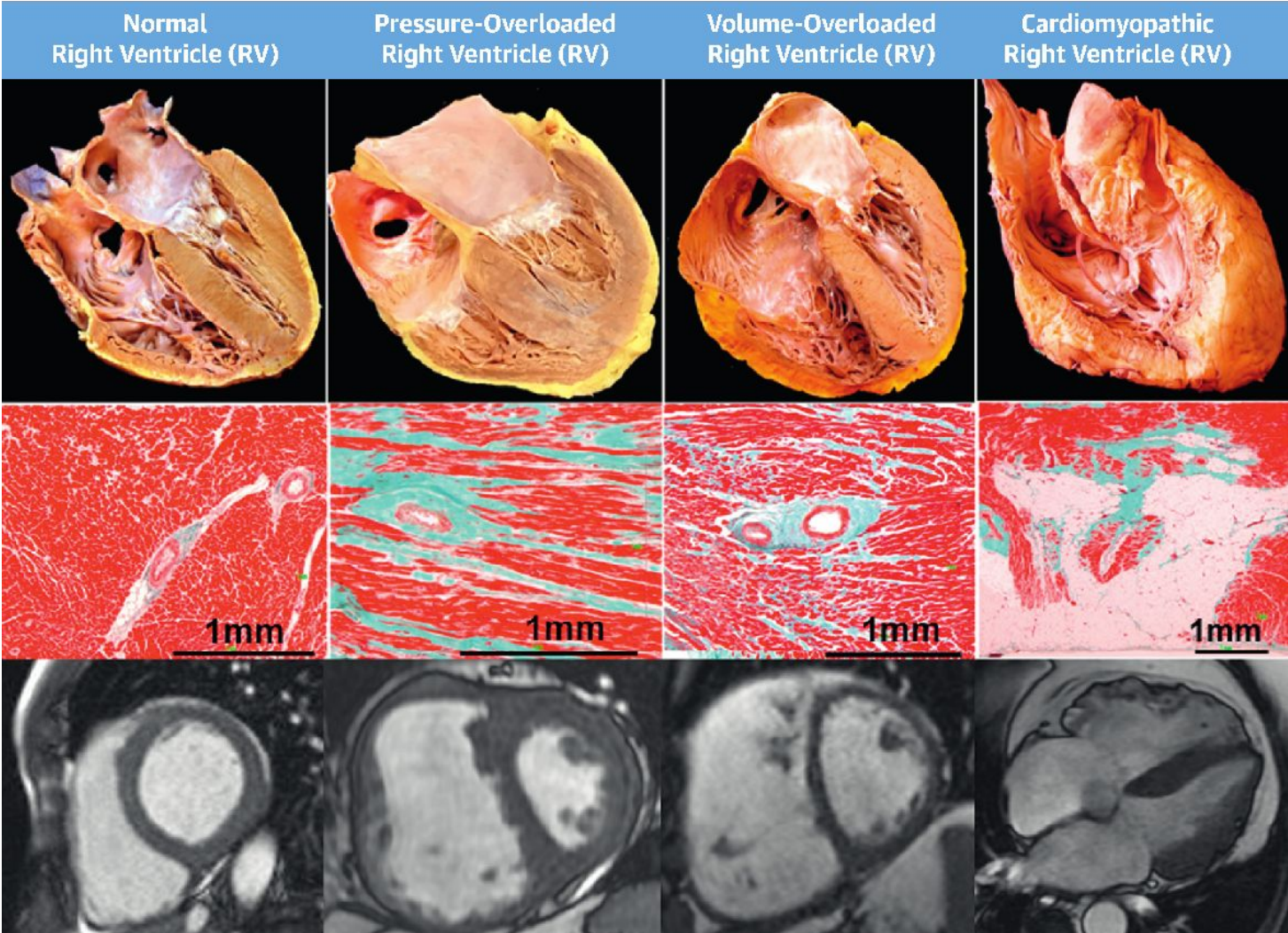
The underlying cause affects the right ventricle morphology/function



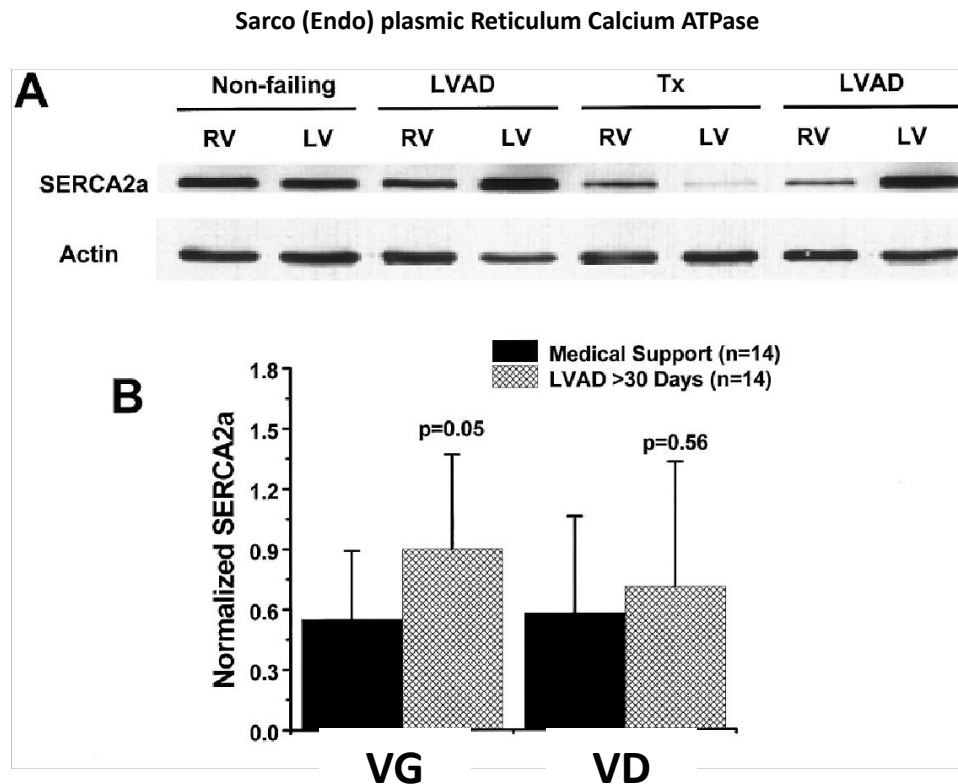
- Decrease of RVEF and LVEF
- Early decrease of LEFi and AEFi
- Radial motion compensate these alterations

■ Longitudinal motion
■ Radial motion
■ Ant-post motion

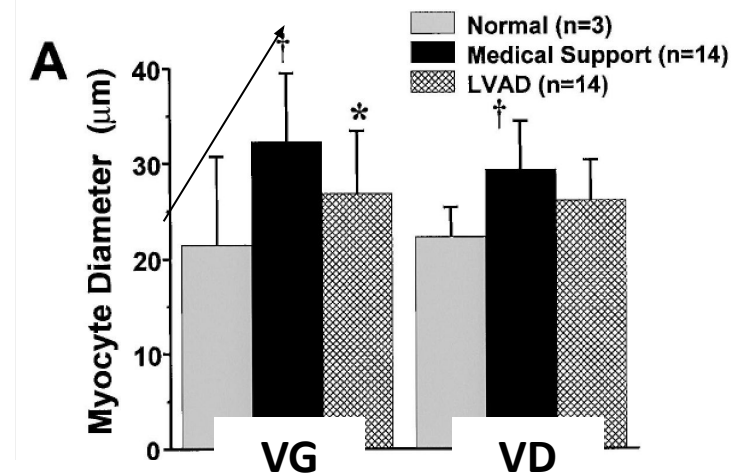
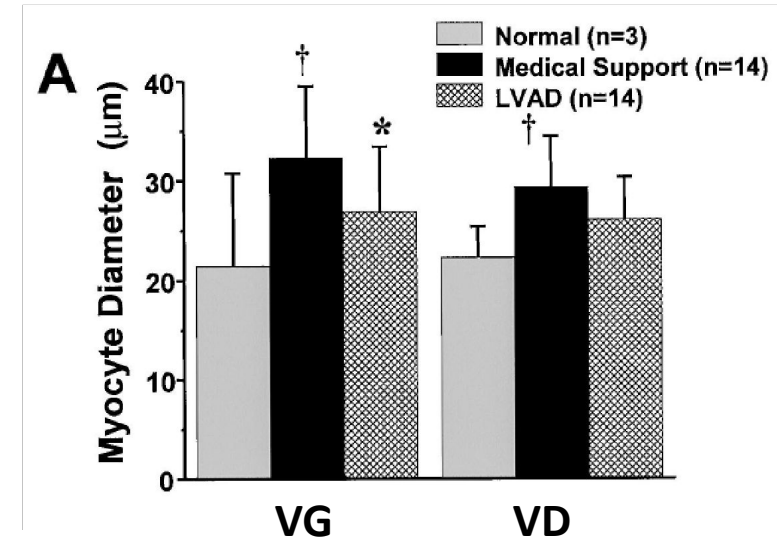
Are all RVD the same ?



LVAD improve LV remodeling but not RV remodeling



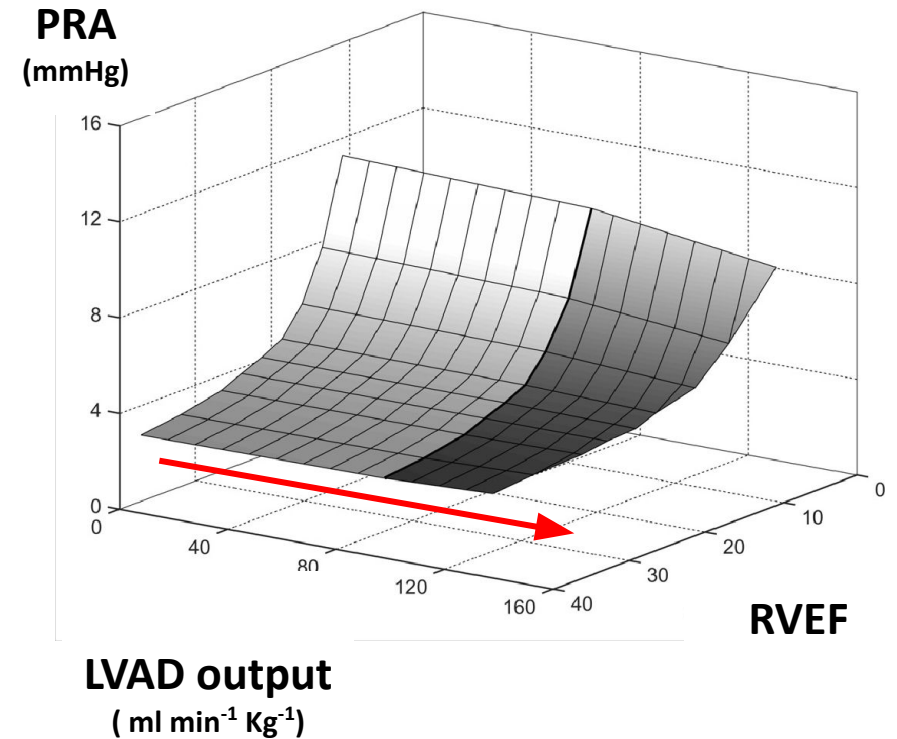
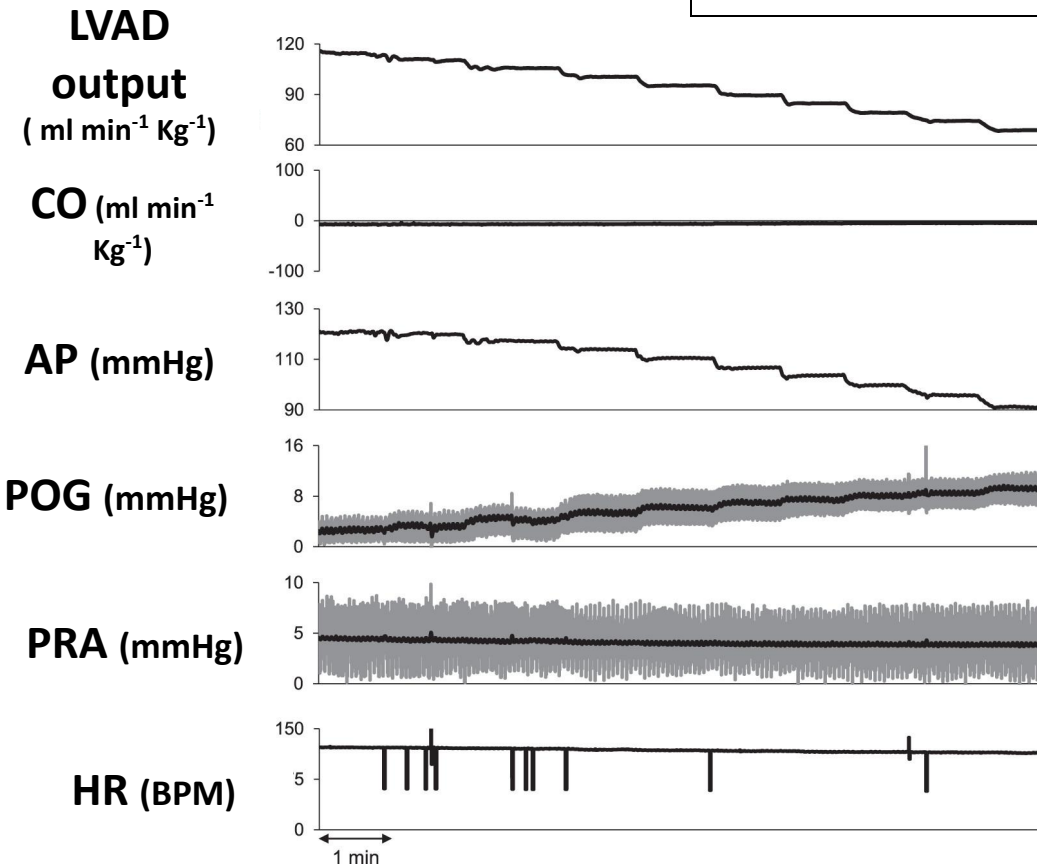
53 patients insuffisants cardiaques et 34 LVAD



Does LVAD increase RV preload ? Not certain

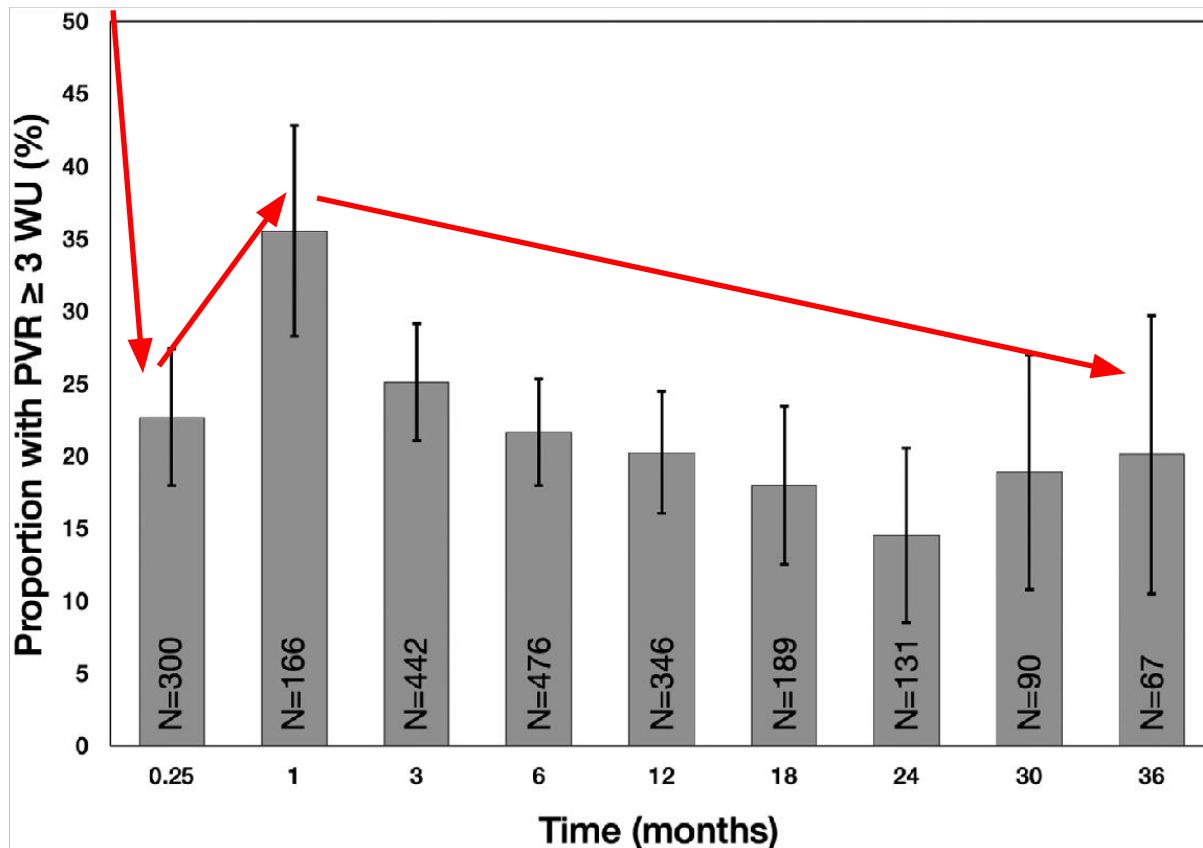
LVAD flow has few effects on PRA except:

- *RVD*
- *Pulmonary hypertension (RVP)*



The RV afterload: don't forget *RVP* thus mitral/tricuspid valvulopathy

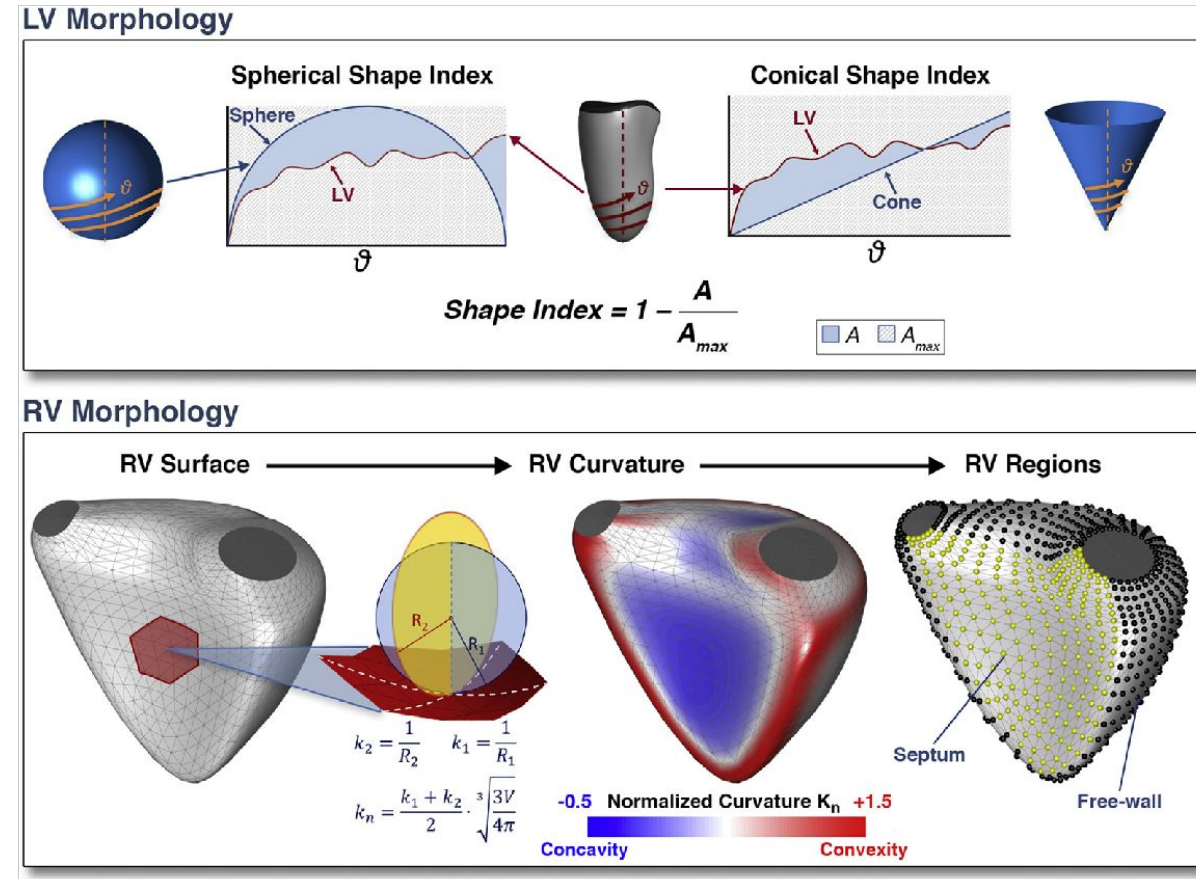
1581 patients from INTERMARCS and RVP > 3 WU



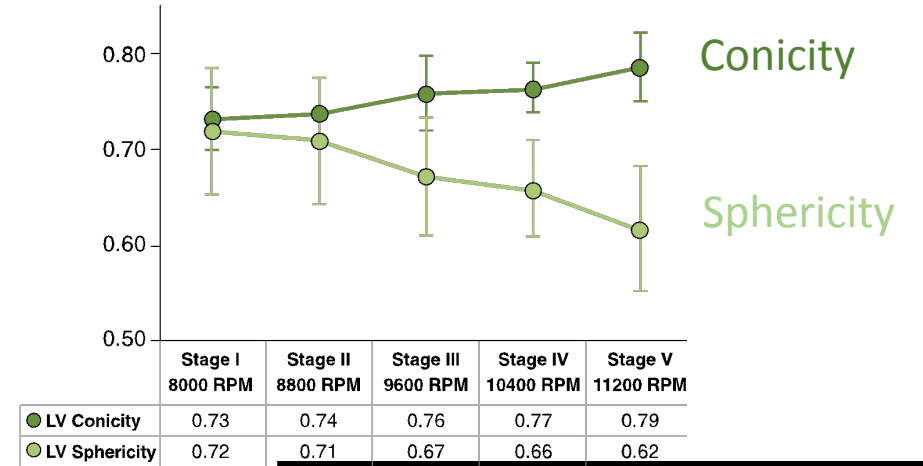
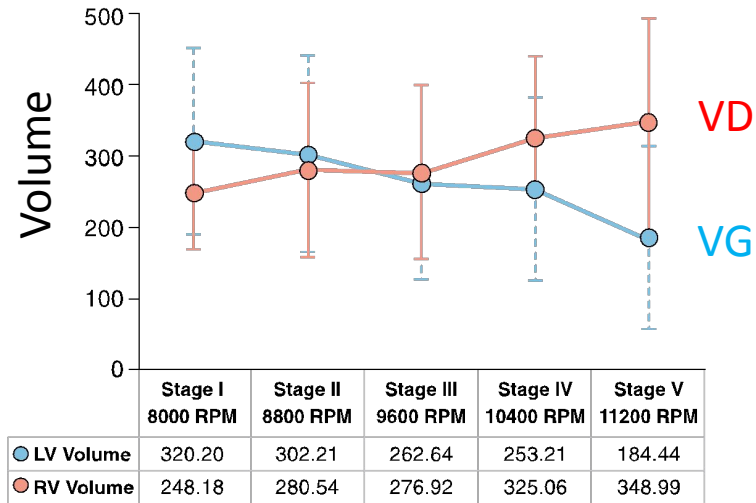
	N = 1581		
	beta	95% CI	P value
Age (per 10 years)	0.06	(0.01 to 0.11)	.013
Height (per 10 cm)	-0.10	(-0.18 to -0.03)	.007
Weight (per kg)	0.003	(0 to 0.006)	.023
PASP (per 5 mm Hg)	0.31	(0.28 to 0.34)	<.001
PADP (per 5 mm Hg)	0.55	(0.49 to 0.60)	<.001
PCWP (per 5 mm Hg)	-0.89	(-0.96 to -0.83)	<.001
CO (per L/min)	-0.78	(-0.84 to -0.72)	<.001
Tricuspid regurgitation at any time			
None	ref		
Mild	-0.27	(-0.48 to 0.06)	.012
Moderate	-0.01	(-0.24 to 0.23)	.94
Severe	-0.07	(-0.37 to 0.23)	.64
Mitral regurgitation at any time			
None	Ref		
Mild	0.1	(-0.07 to 0.28)	.24
Moderate	0.81	(0.60 to 1.01)	<.001
Severe	1.29	(1.05 to 1.52)	<.001
Concomitant mitral valve surgery			
At median LVEDD (6.9 cm)	-0.18		.014
Per 1 cm decrease in LVEDD	-0.27	(-0.49 to -0.04)	.020
Duration of LVAD support (per month)			
0-3 months	-1.53	(-1.79 to -1.27)	<.001
≥3 months	-0.066	(-0.07 to -0.06)	<.001

RV/LV interactions during LVAD support

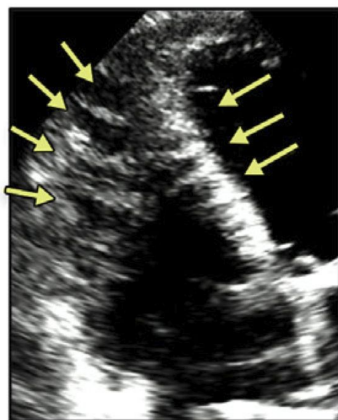
- Interventional study on 31 LVAD supported patients (HM₂/HVAD)
- Ramp-test with echocardiography measures (volumetric/geometric)
- Sphericity, conicity, shape/curve, RV/LV volume



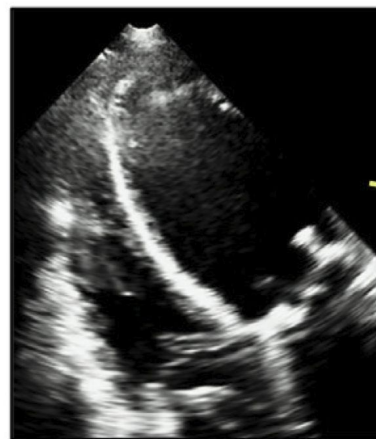
RV/LV interactions during LVAD support affect RV morphology thus RV function



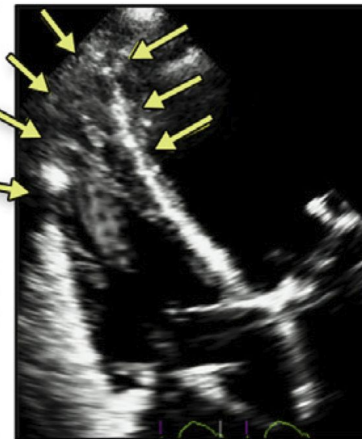
8000 RPM
(Lowest speed)



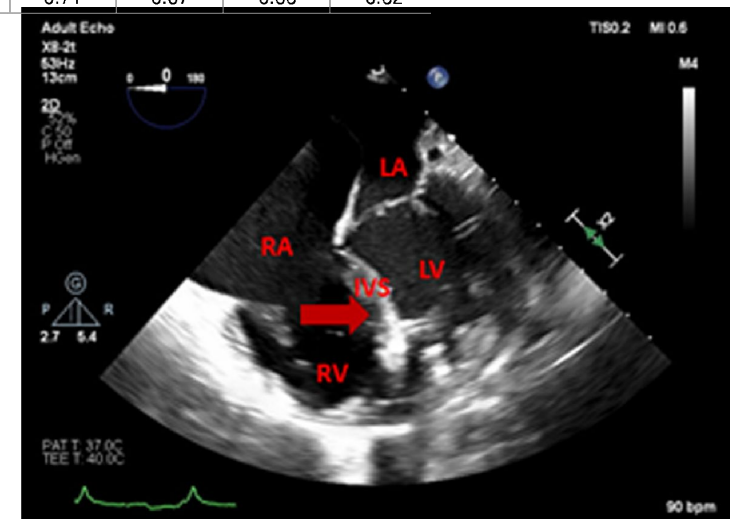
10400 RPM
(Highest speed)



2300 RPM
(Lowest speed)



3200 RPM
(Highest speed)

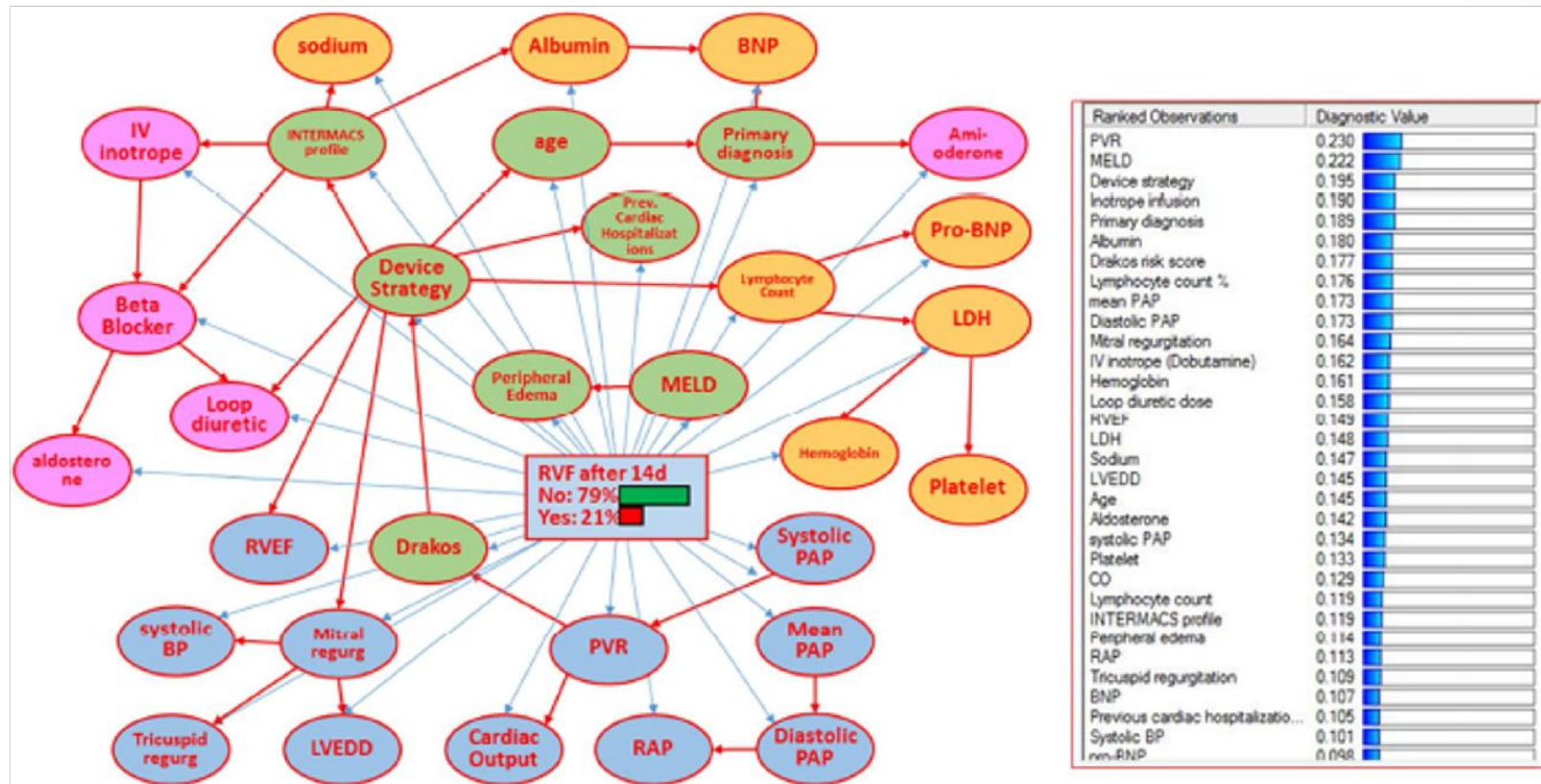


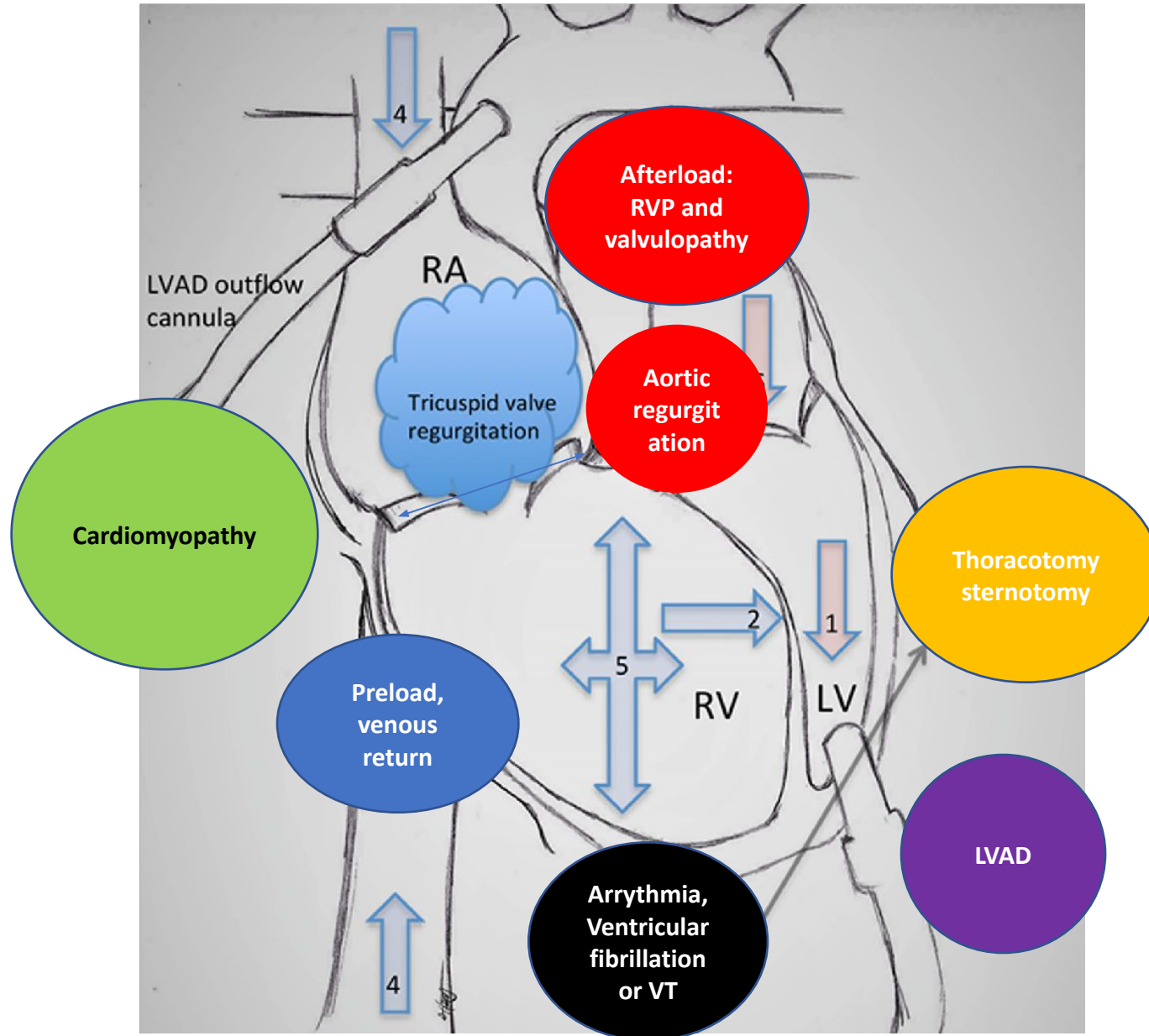
In summary So many factors, so difficult and complex



Bayesian analysis to predict « late » RVD

Database n=10,909





How to diagnose RVD?

Clinical examination, biological

Weight, treatment

Hepatic (PAL, GT, bilirubine),
creatinine...

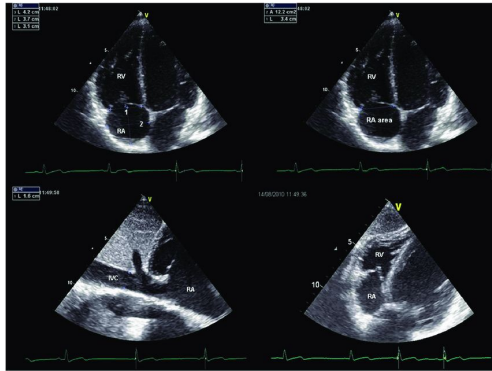
Clinical, biological,
echocardiography scores ?

Echocardiography, pulmonary pressure, ramp test?

Echogenicity, which parameters?
how when...

Invasive non invasive

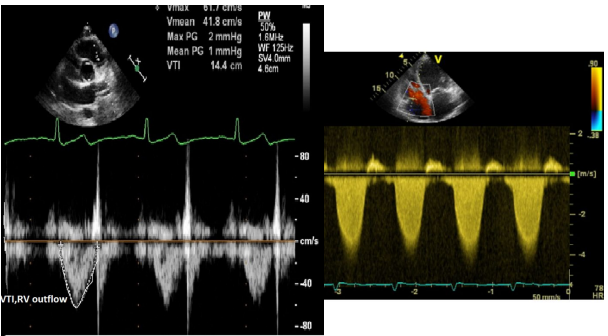
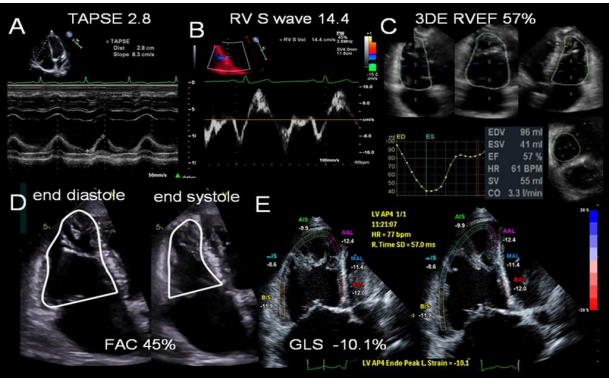
Echocardiography : combination of several components (static, dynamic, volumetric, coupling)



Preload: IVC
(diameter,
collapsibility)
portal flow

LVAD

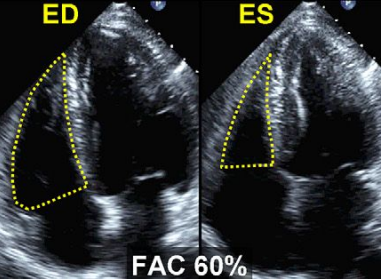
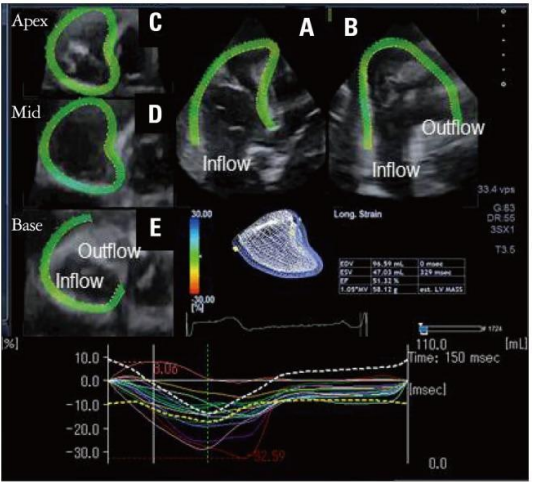
Coupling
VD/AP:
TAPSE/PASP,
TAPSE/RV-GLS
ou fwLs



Afterload,
pulmonary
flow



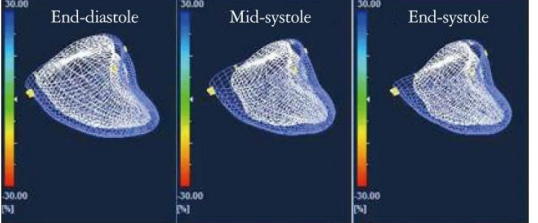
Size
ratio diam
VD/VG,
DTDVG,
DTDVD



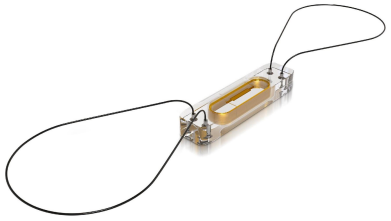
Contractility:
RVFAC, Strain
(global RV-GLS
/paroi libre
RV-fwLS)



Valvulopathy:
mitral, aortic,
tricuspid







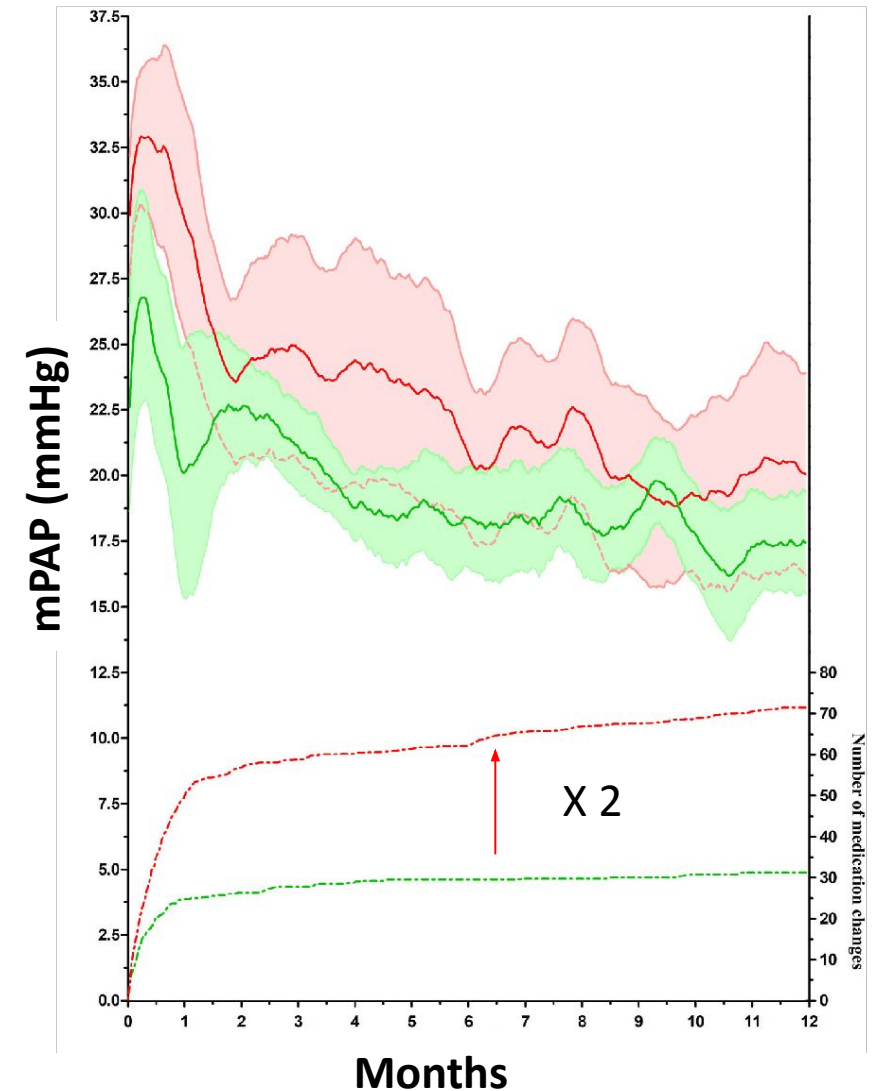
Continuous « non »invasive pulmonary blood pressure monitoring



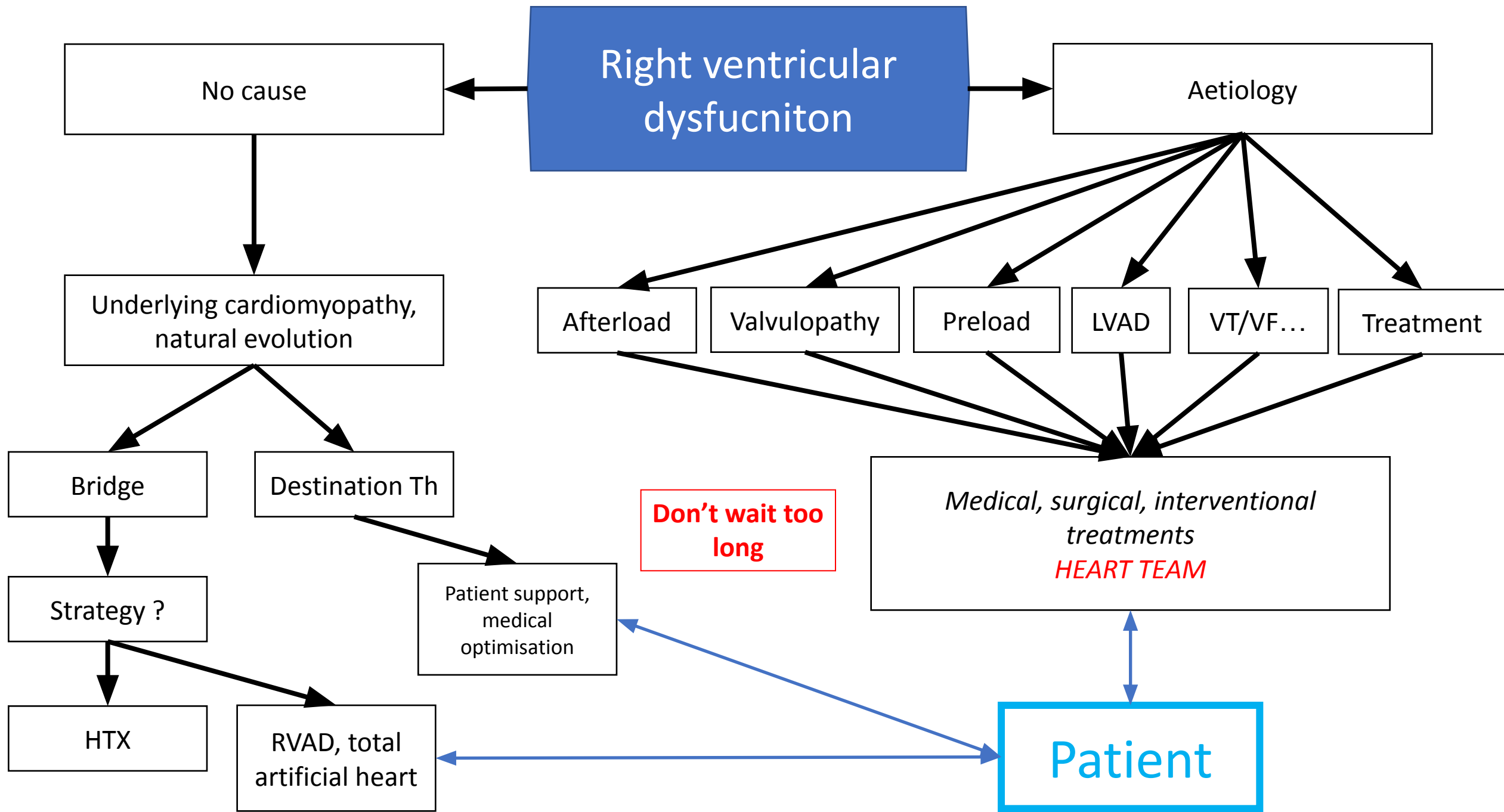
Retrospective matched cohort study : 10 cardiomeas patients vs 20 controls

No related complications, easy, informative

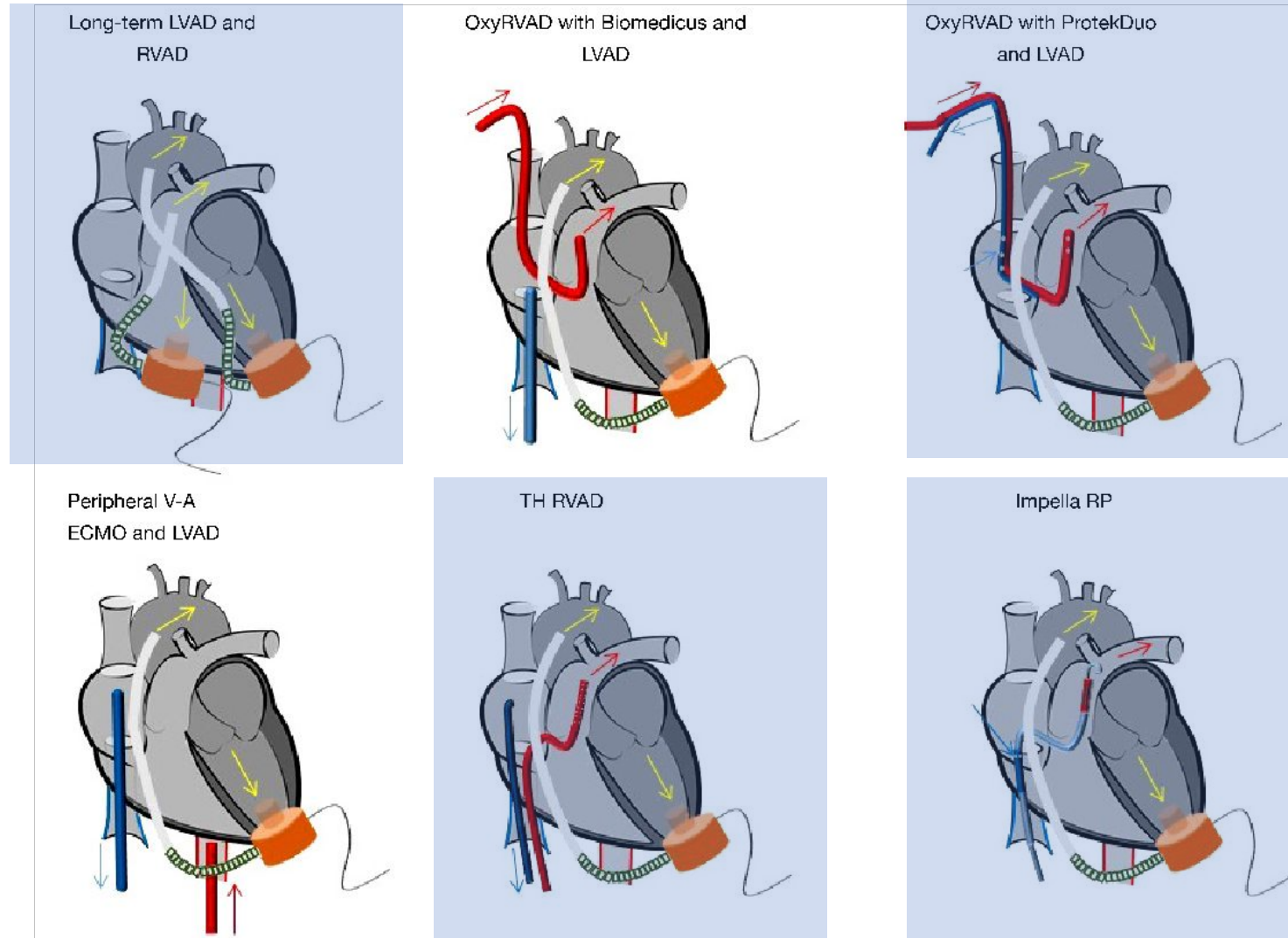
-  mPAP in elevated mPAP patients
-  mPAP in normalized mPAP patients
-  Number of medical changes in elevated mPAP patients
-  Number of medical changes in normalized mPAP patients



Which therapeutic strategy ?

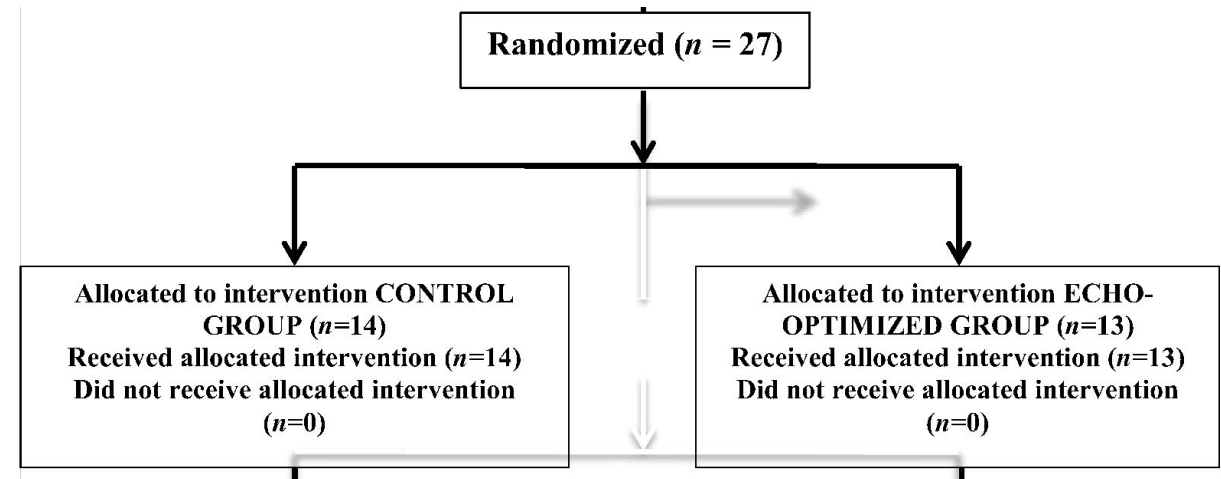


So many mechanical RV configurations: Don't wait to make a decision

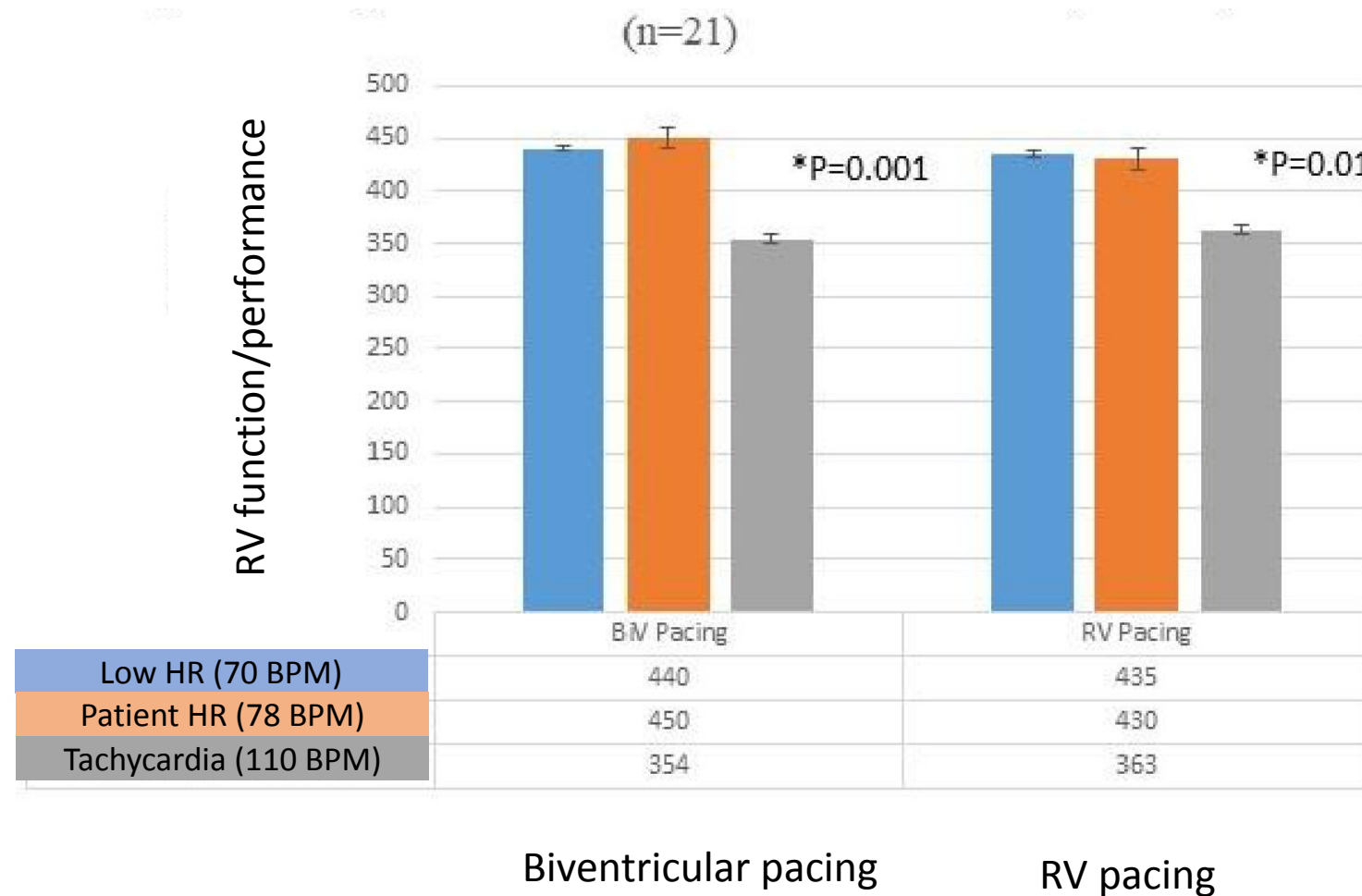


Effects of echo-optimization of left ventricular assist devices on functional capacity, a randomized controlled trial

ETT: The optimal velocity was defined as the one that allows an **intermittent AV opening** and a **neutral position of the inter-ventricular septum** without increasing **aortic and/or tricuspid regurgitation, associated or not to a dilatation of the RV.**



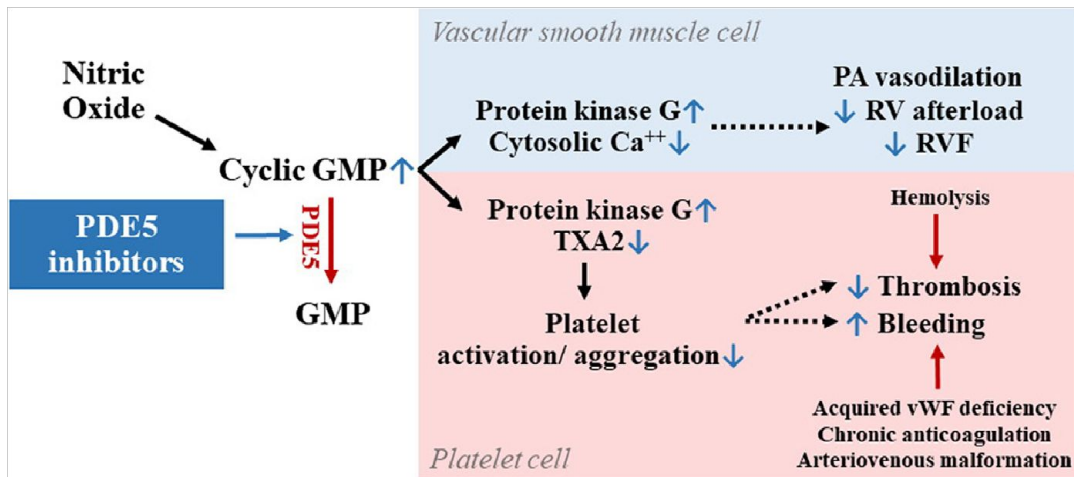
Don't play with heart rate and pacing?



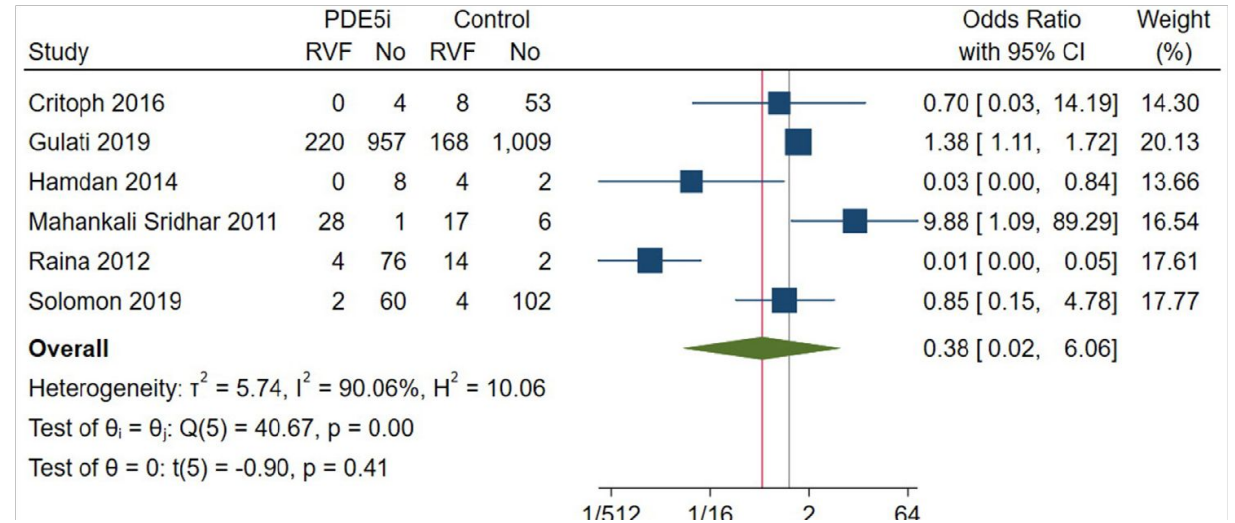
Phosphodiesterase-5 Inhibitors and Outcomes During Left Ventricular Assist Device Support: A Systematic Review and Meta-Analysis

Journal of Cardiac Failure Vol. 27 No. 4 2021

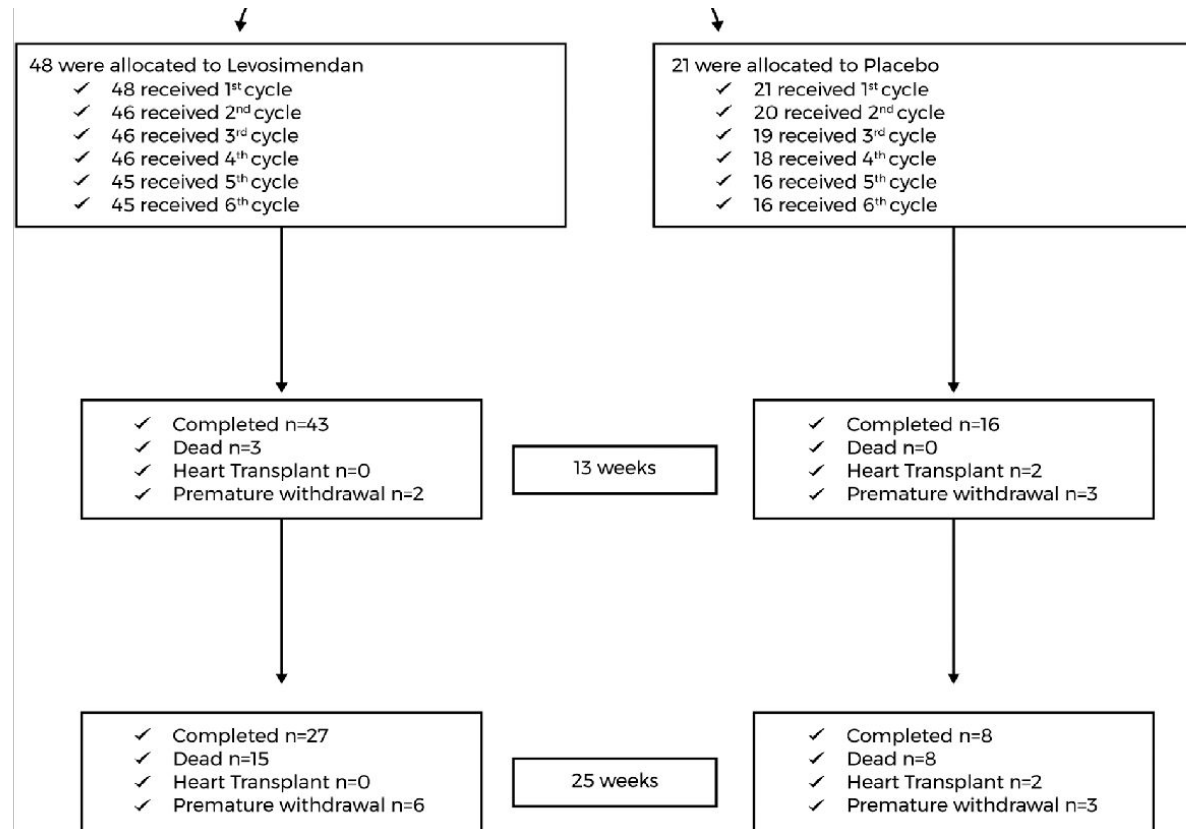
Guidelines: In case of pulmonary hypertension or risk of RVD
PDE3



Right ventricular dysfunction



Eff cacy and safety of intermittent intravenous outpatient administration of levosimendan in patients with advanced heart failure: the LION-HEART multicentre randomised trial



Conclusions

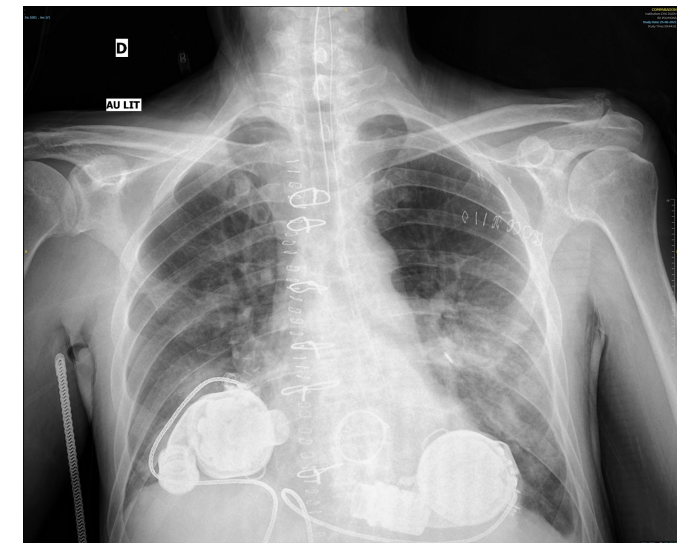
- Mild/late onset RVD □ 10% morbidity, mortality
- Multifactorial process, no good score, multifactorial evaluation
- Medical, cardiological, surgical treatment
- Don't forget RV mechanical support

60 years old man with valvular and rythmic cardiomyopathy

HM3 support as bridge to HTX
Simple post operative course but...



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Biologie			↑ Creat, cholestase	↑ Creat, ↑ bili	↑Creat ↑ bili



Thank you