

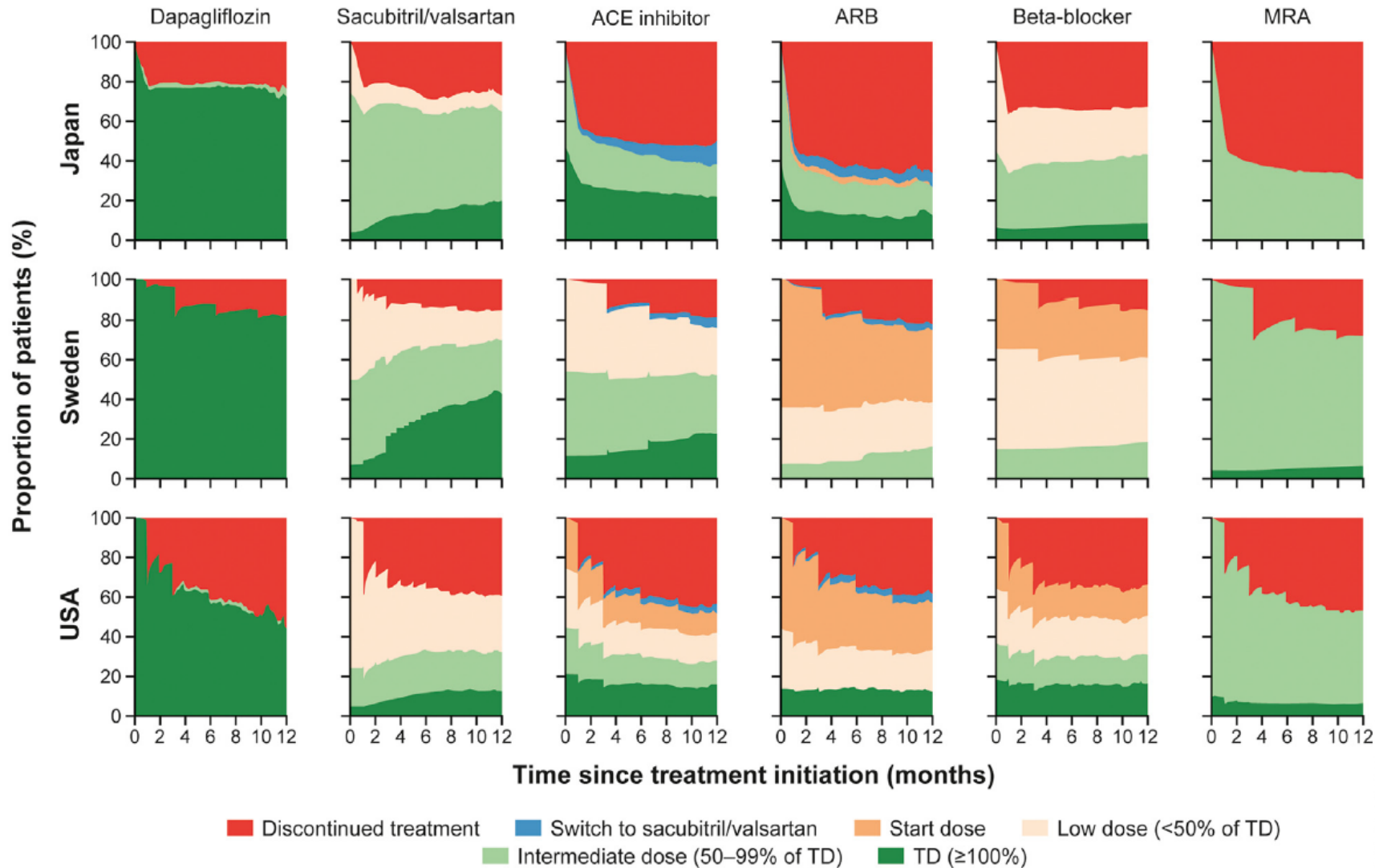
Shunt interatriale come nuova frontiera nel trattamento dello scompenso cardiaco

Sergio Berti

Ospedale del Cuore

Fondazione C.N.R. Reg. Toscana, Massa/Pisa

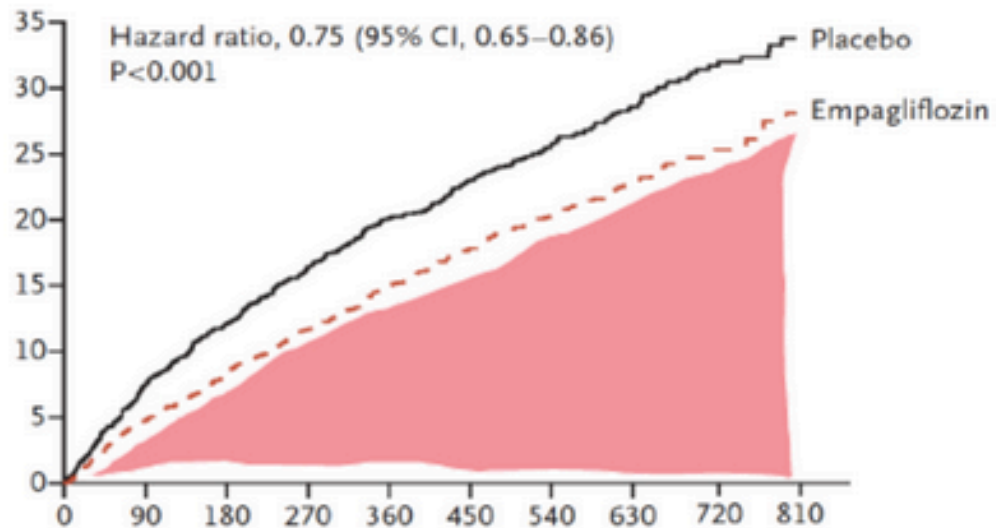
berti@ftgm.it



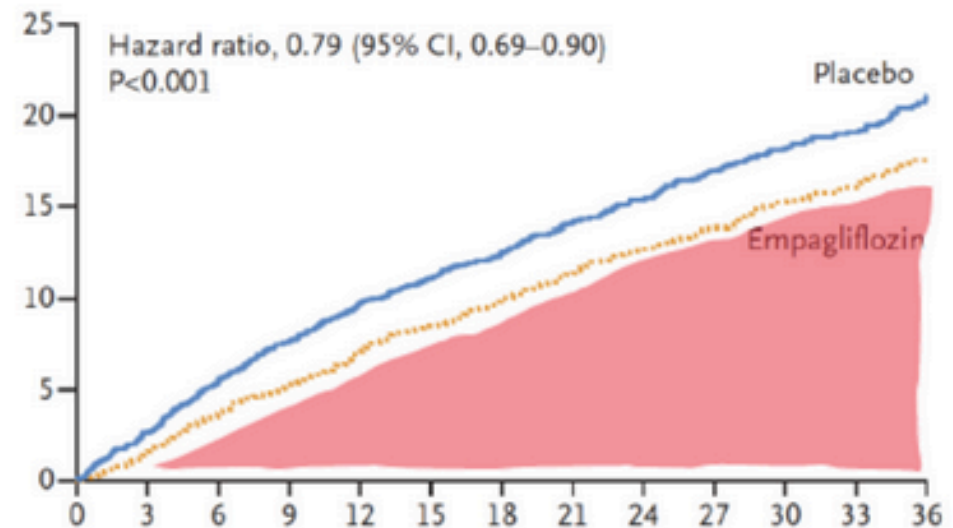
Savarese G al 2023, Heart Failure drug treatment – Inertia, titration and discontinuation, JACC

Residual risk of HF patients on GDMT

Heart Failure with reduced ejection fraction
CV mortality and HF hospitalization¹

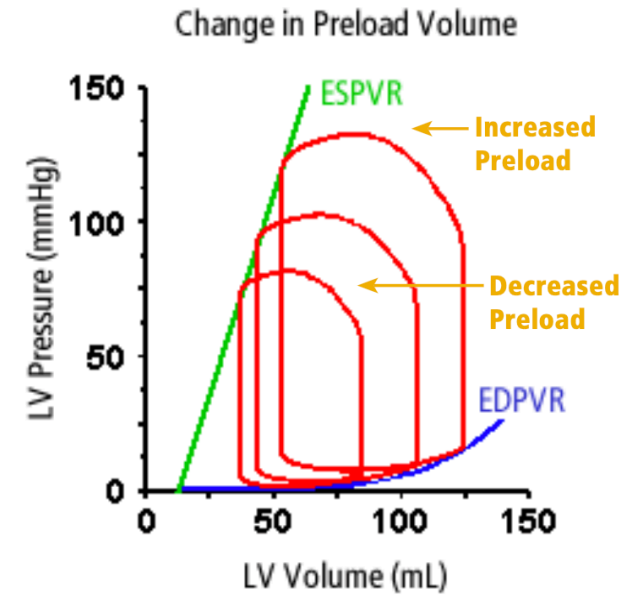
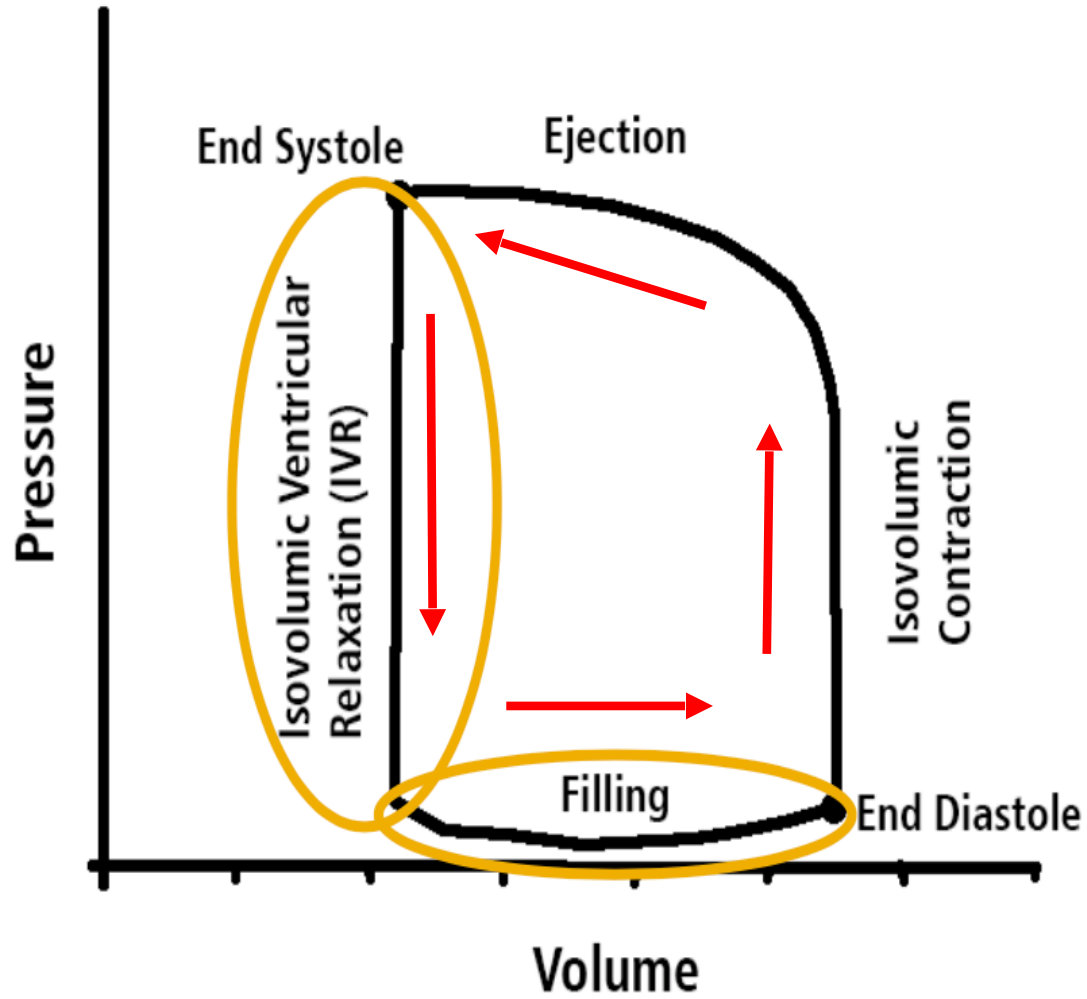


Heart Failure with preserved ejection fraction
CV mortality and HF hospitalization²

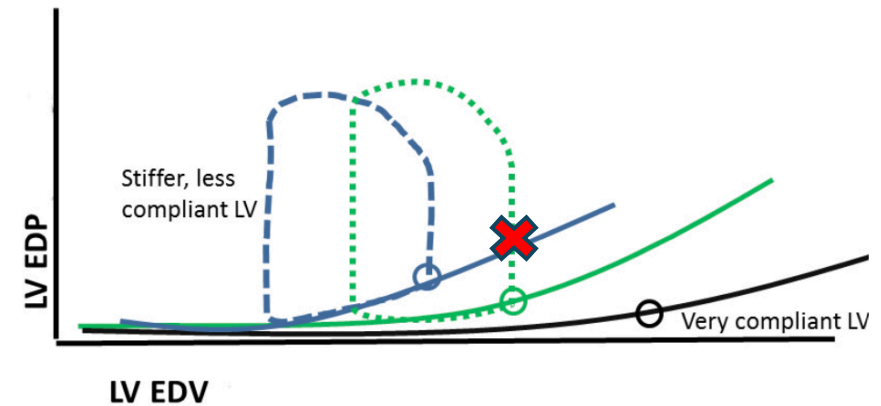


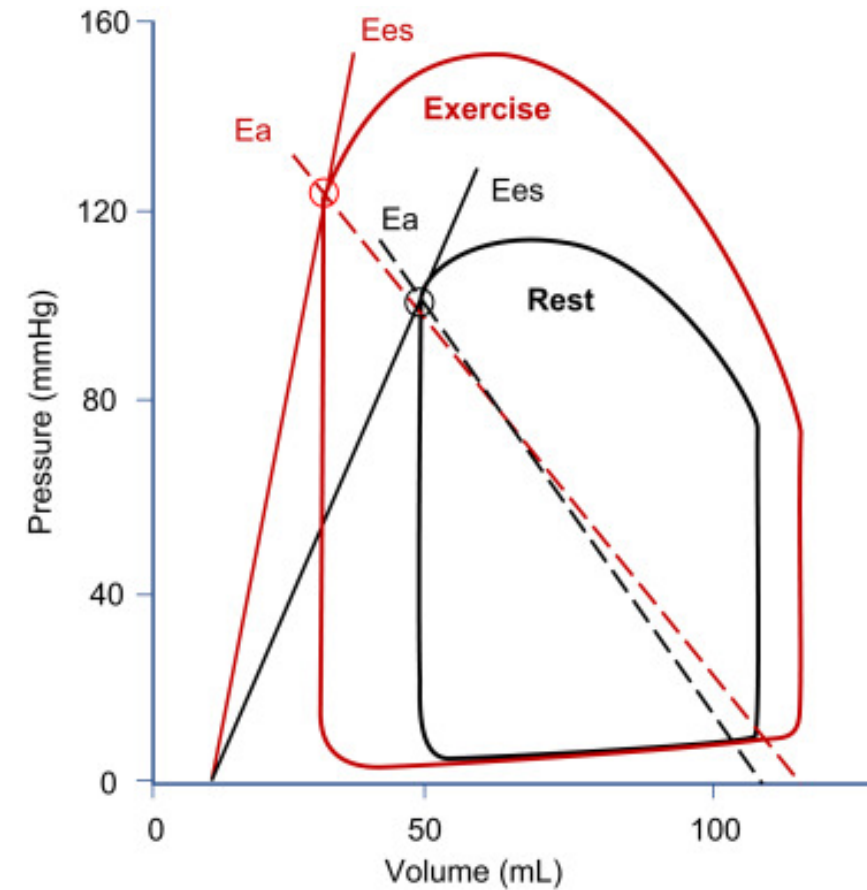
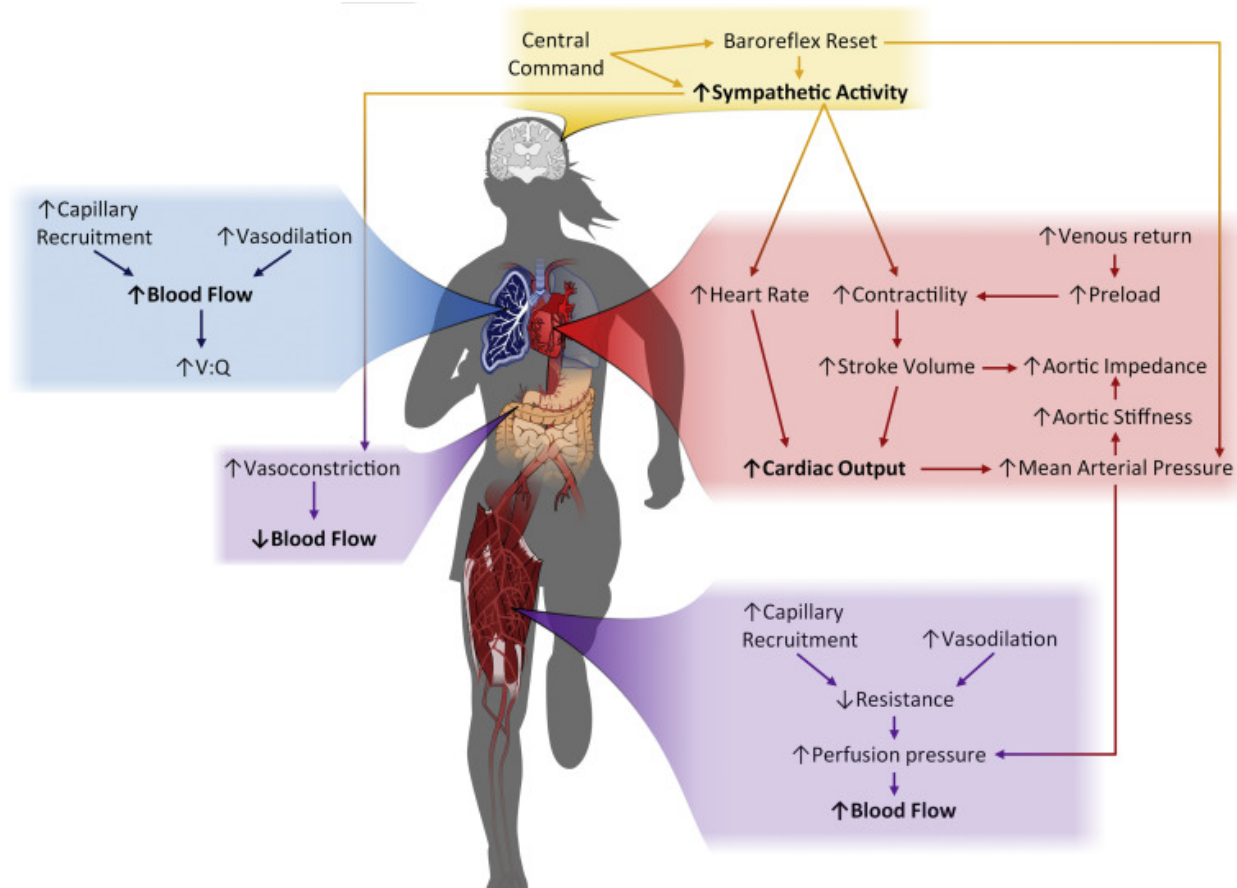
Greene S et al. Management of Worsening Heart Failure With Reduced Ejection Fraction: JACC 2023

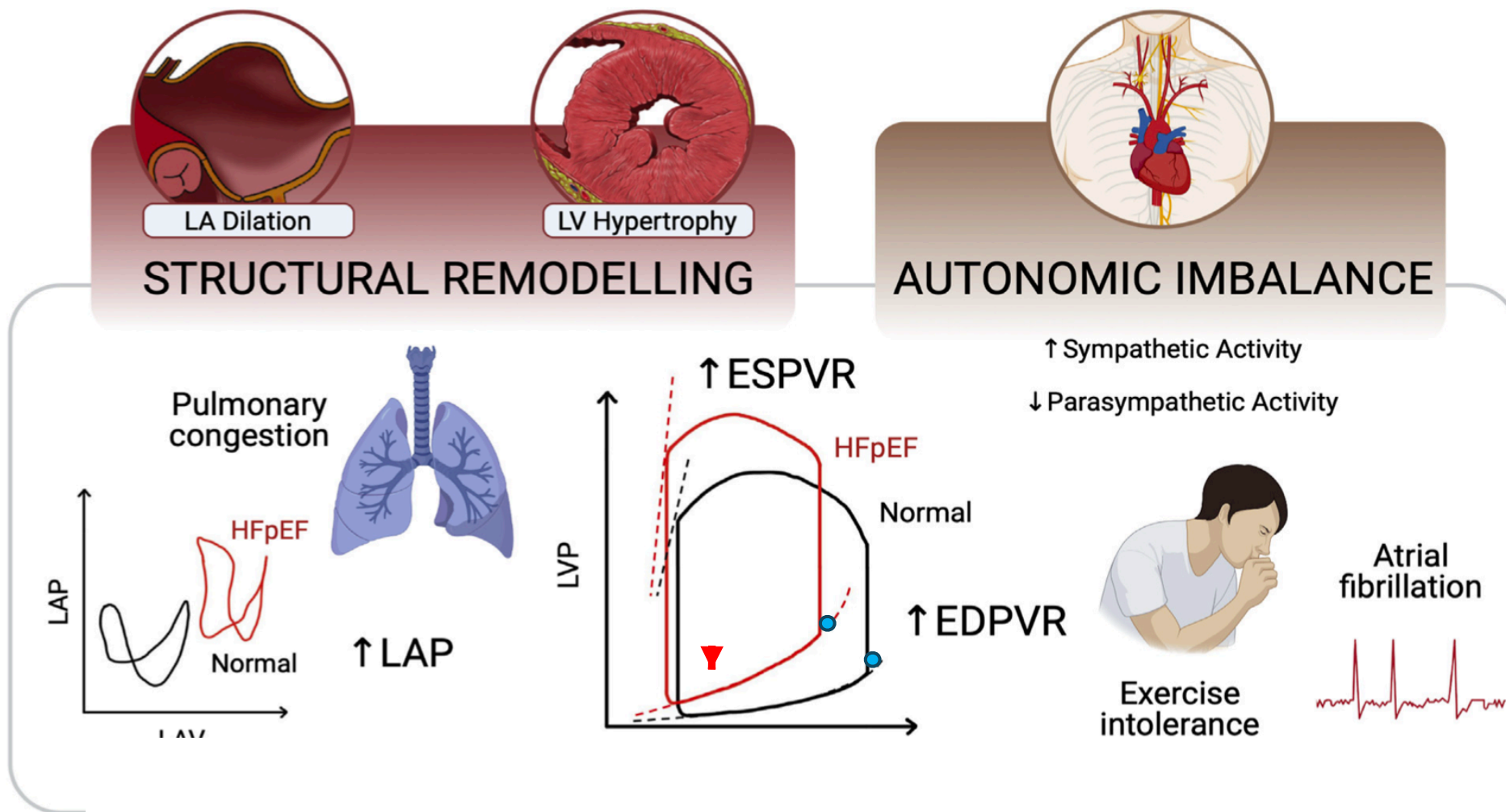




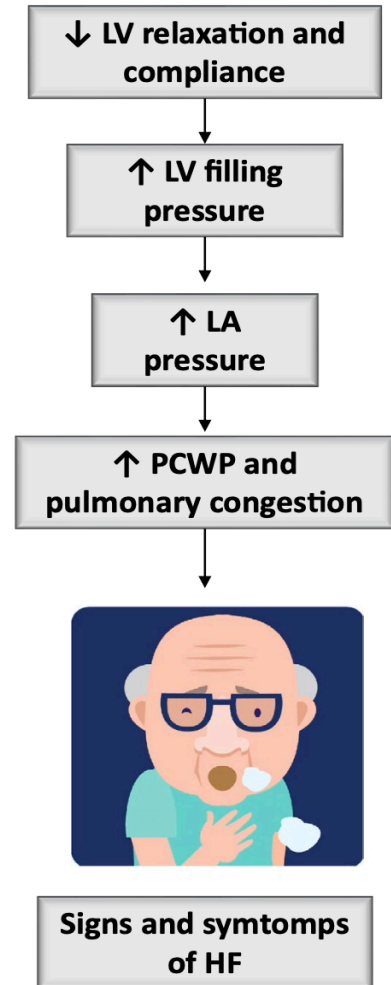
Understanding Lusitropy





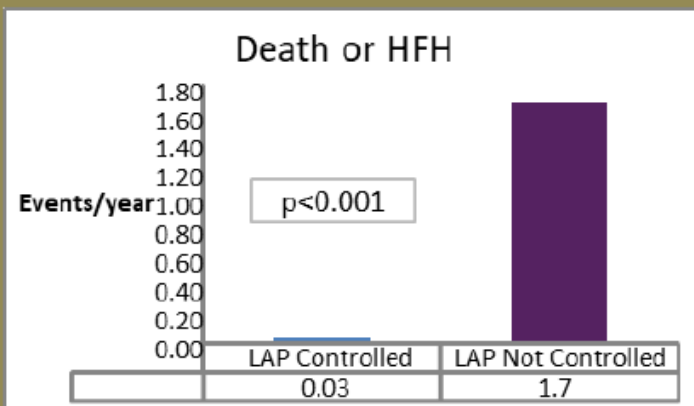


Pathophysiologic mechanisms leading to dyspnoea in patients with HFpEF/HFrEF



Elevated LAP is casual for HF symptoms, morbidity and mortality

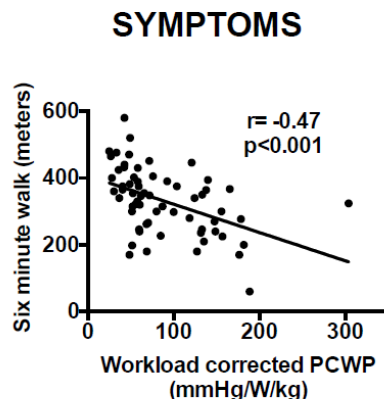
Controlling LAP
reduces HF events



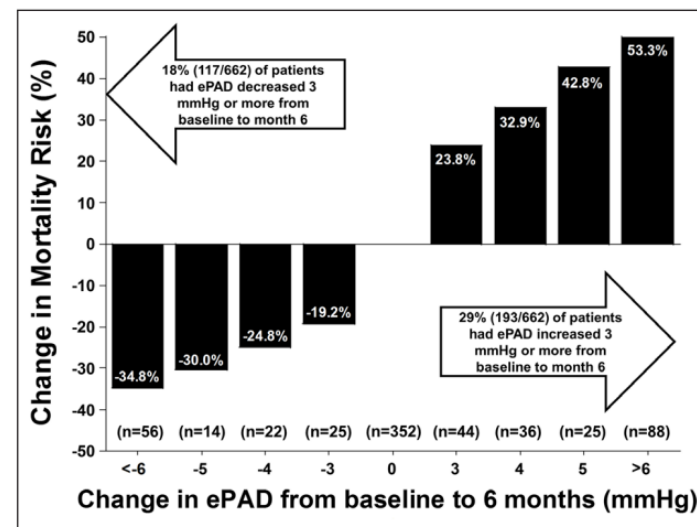
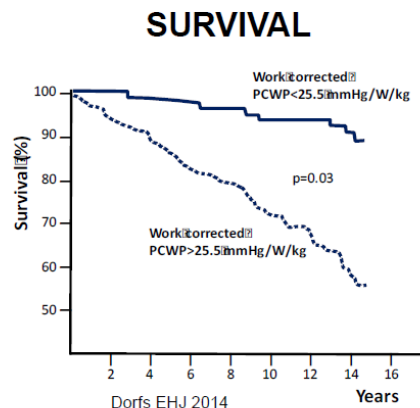
When LAP controlled (trend ≤ 18 mmHg) by pressure-guided medication adjustment, there were significantly fewer HF events

Ritzema J et al. Circulation 2010

The increase in LA pressure in HFpEF causes symptoms and decreases survival



David M Kaye, REDUCE LAP-HF, AHA 2016



Zile et al. Circ.Heart Fail. 2017



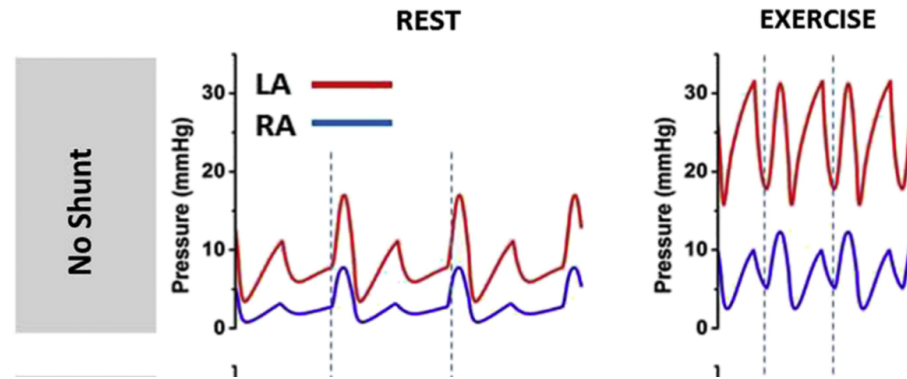
- *Patients with mitral valve stenosis and an atrial septal defect (ASD) have fewer symptoms than patients with an intact septum (Lutembacher Syndrome)*
- *Closure of ASDs in patients with unrecognized left ventricular dysfunction results in elevated LAP and pulmonary edema*
- *Pre-clinical animal studies demonstrate hemodynamic, echocardiographic and survival benefits with interatrial shunting*



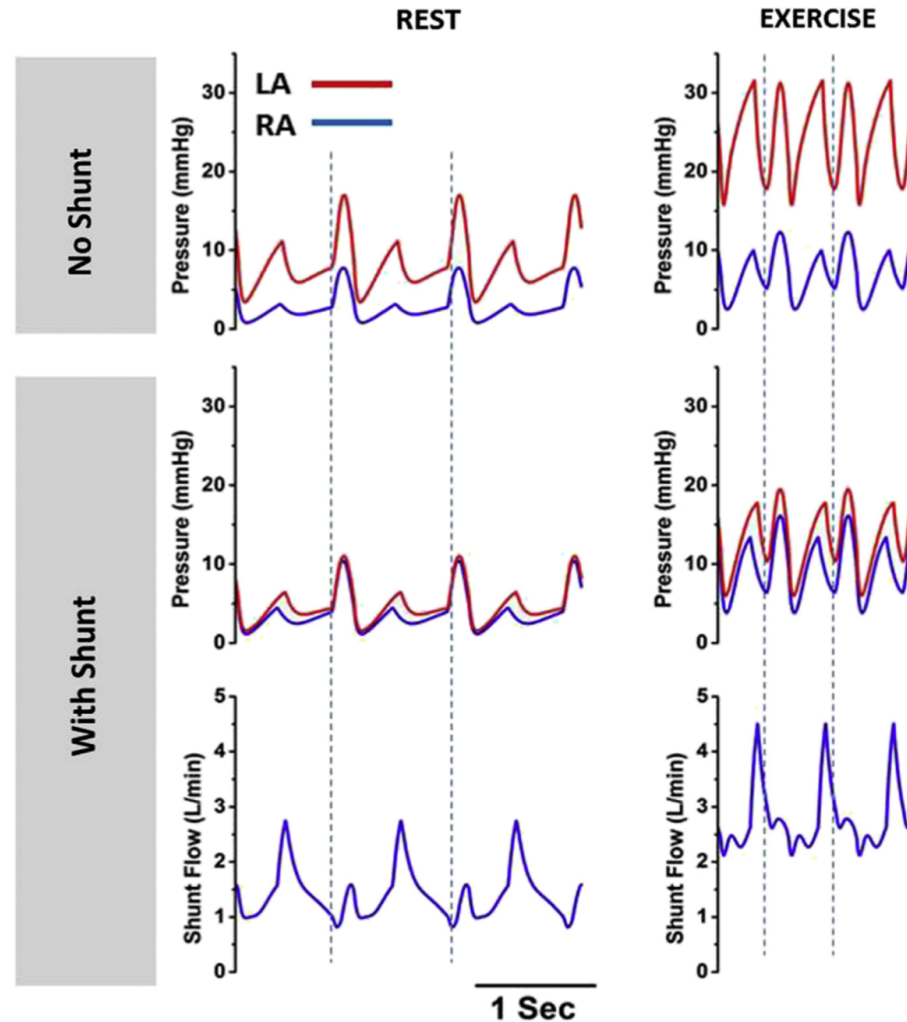
Lutembacher R. De la sténose mitrale avec communication interauriculaire. Arch Mal Coeur. 1916;9:237-60.

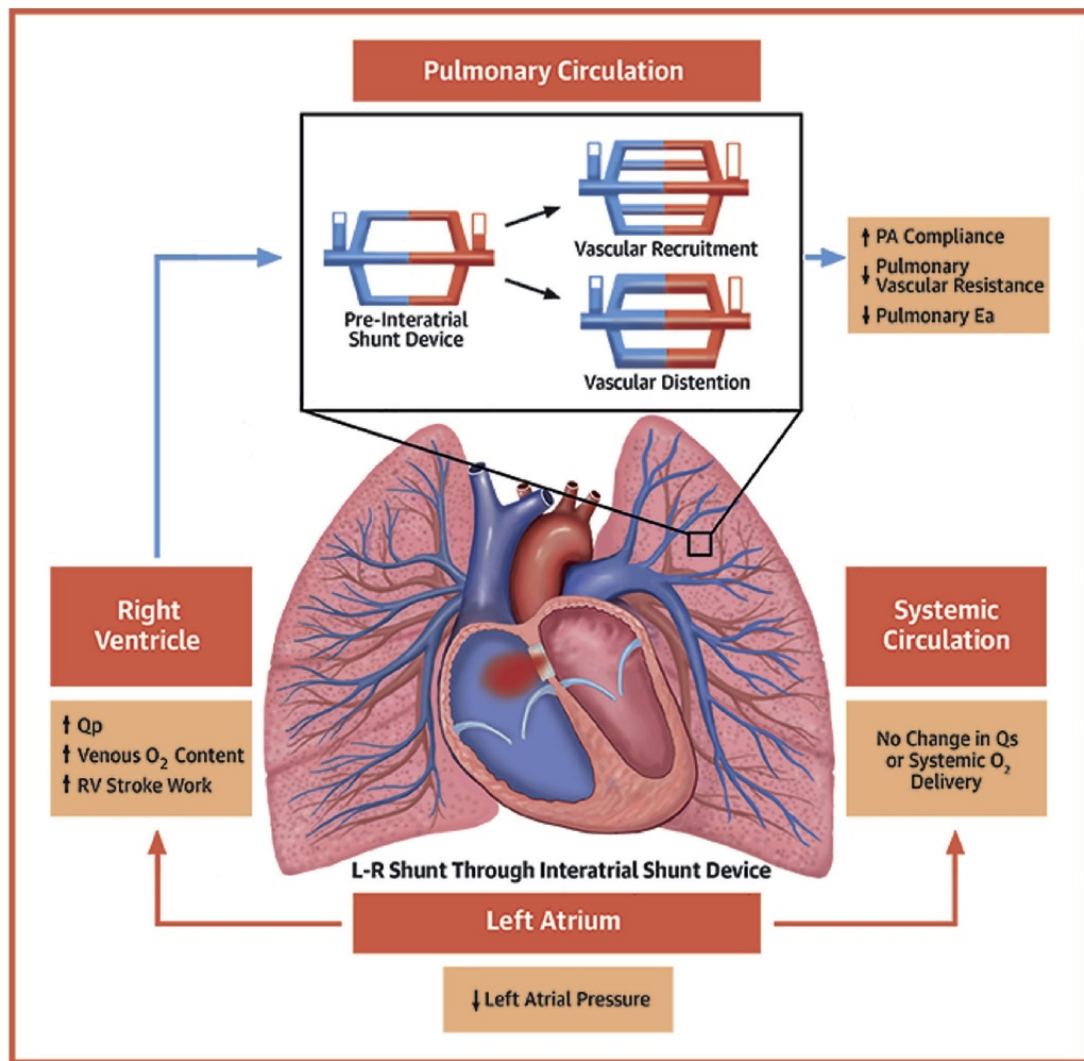


Effects of Interatrial Shunt on Exercise Hemodynamics in HFpEF Patients



Effects of Interatrial Shunt on Exercise Hemodynamics in HFpEF Patients

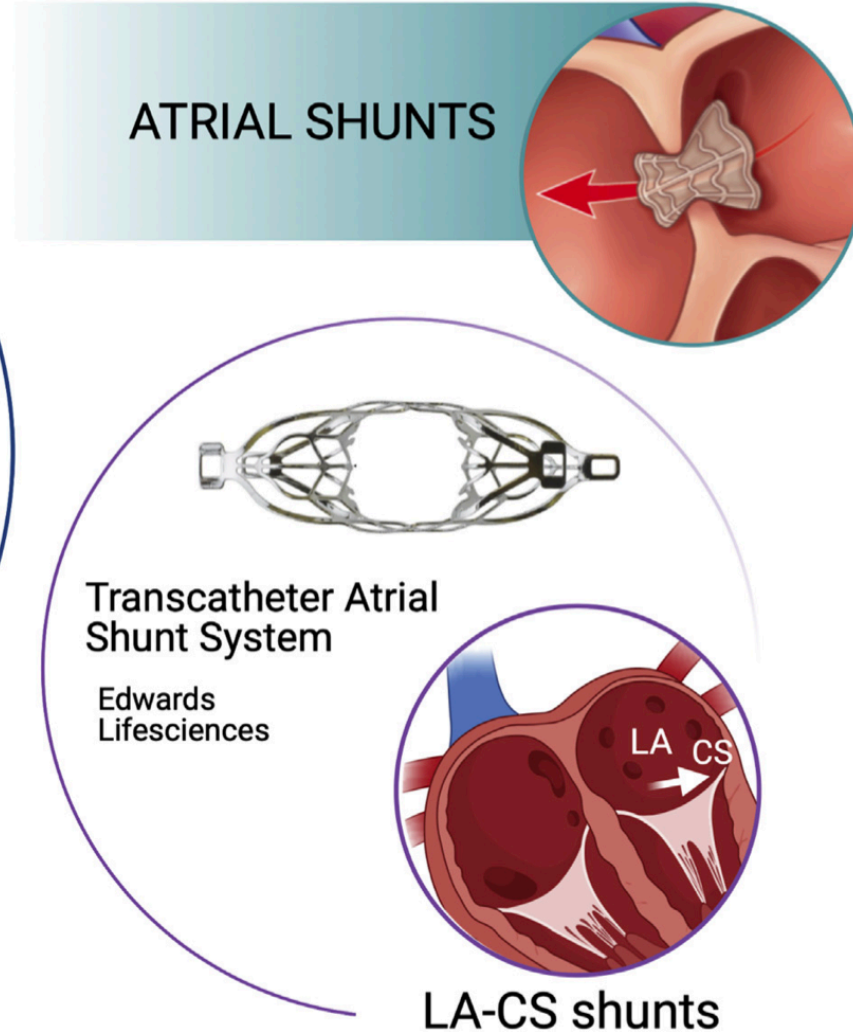
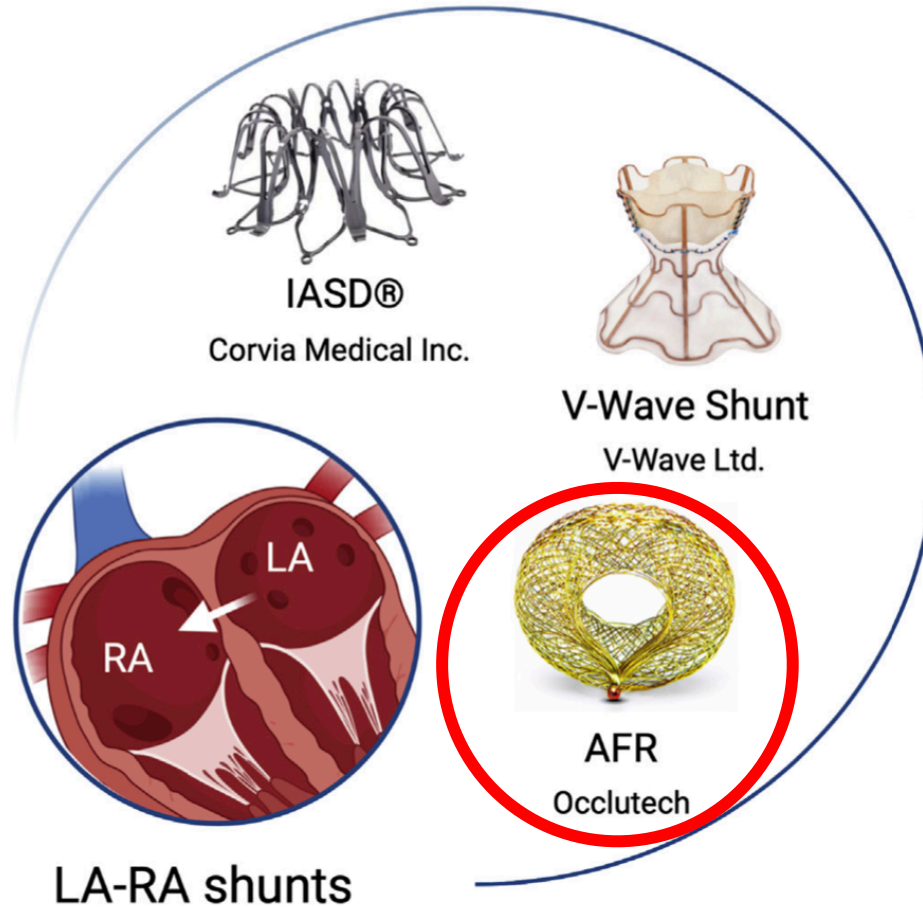


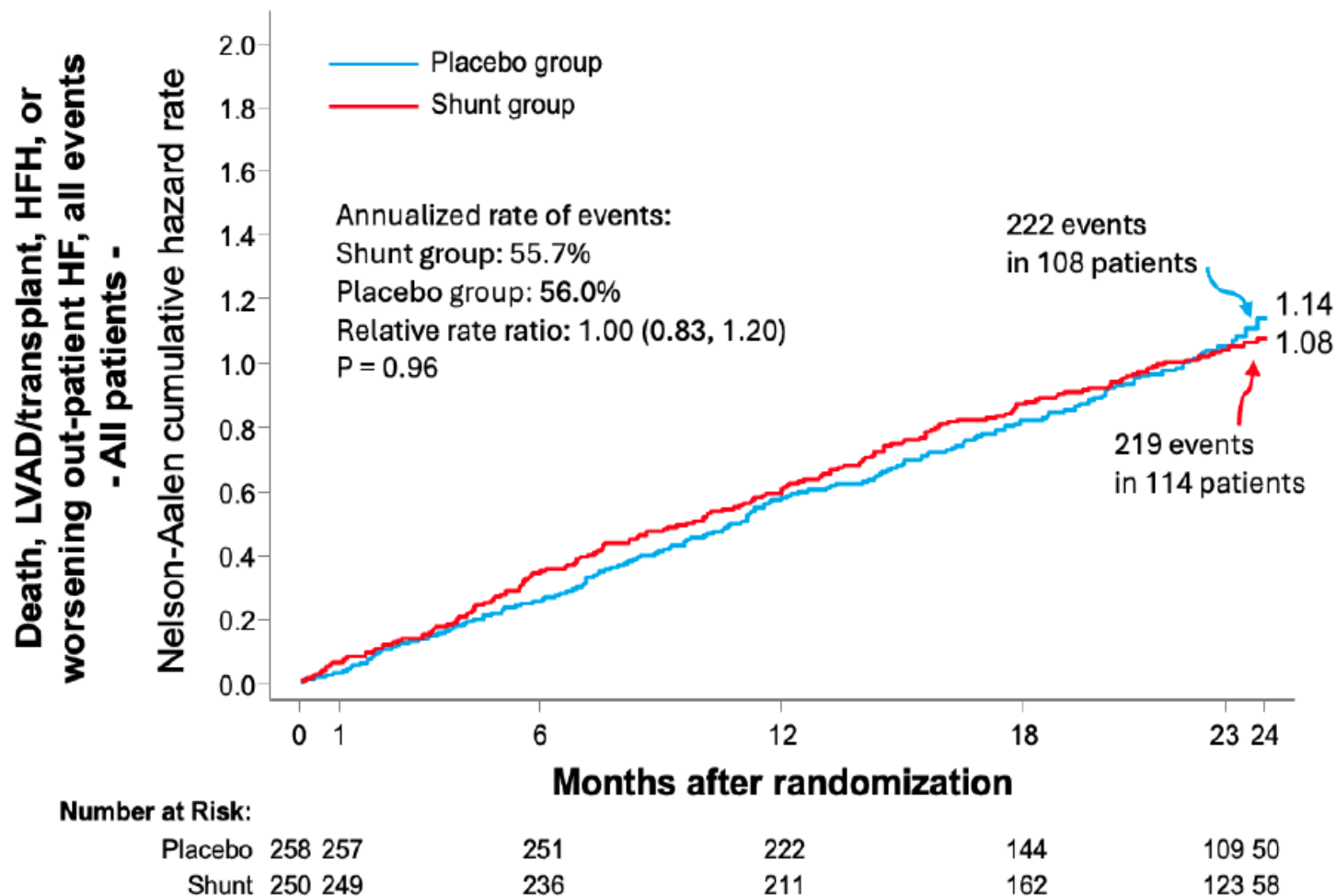


Post shunt:

- Flow dependent vasodilatory effects
- Pulmonary vasodilatation due to ↑ PA O₂ content i(from LA shunting)
- ↓ pulmonary artery pulsatile load due to LA unloading







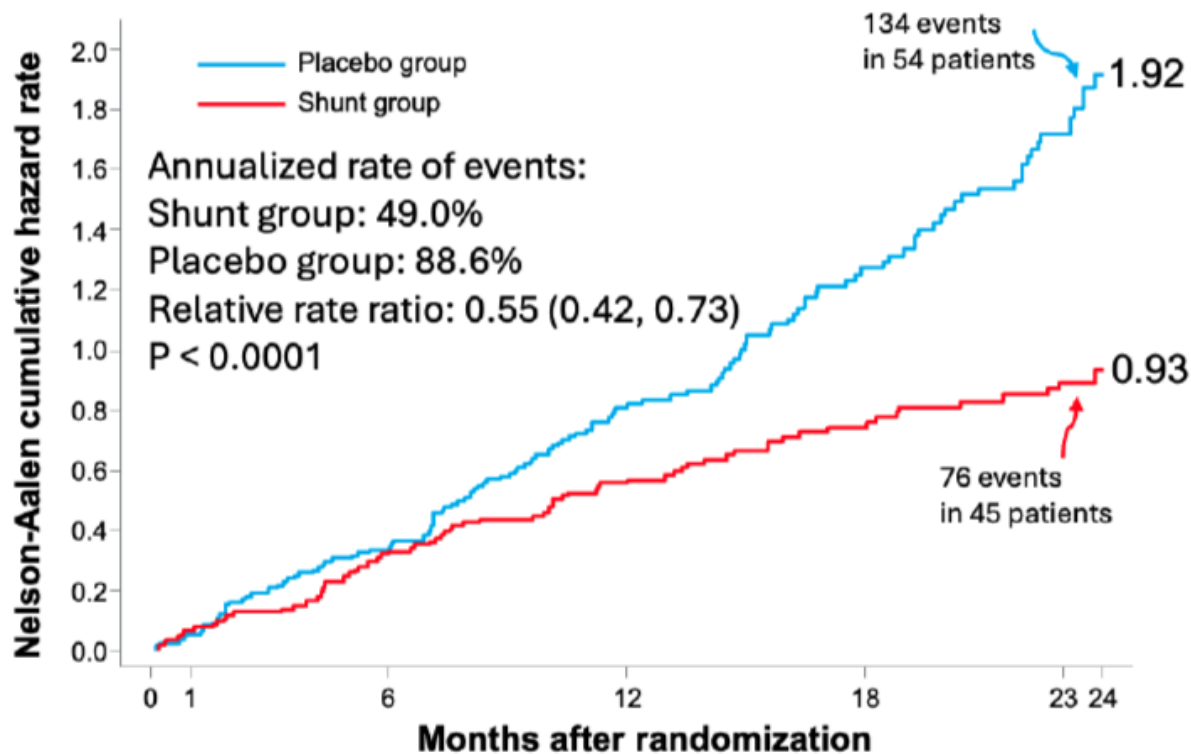
Stone GW et al. Circulation. 2024;150:1931-43



LVEF $\leq 40\%$ (n=206)

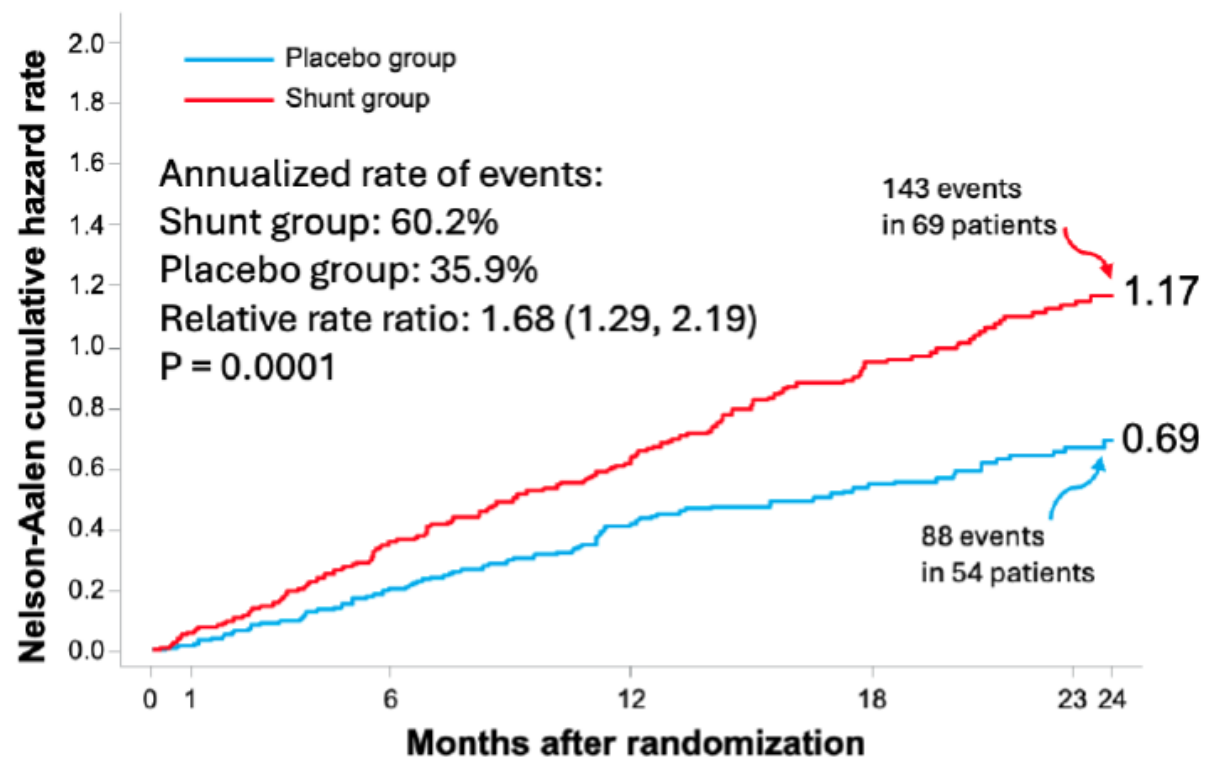
$P_{\text{interaction}} < 0.0001$

LVEF $> 40\%$ (n=302)



N at Risk:

Placebo	105	104	101	84	51	38	19
Shunt	101	101	96	84	60	46	17



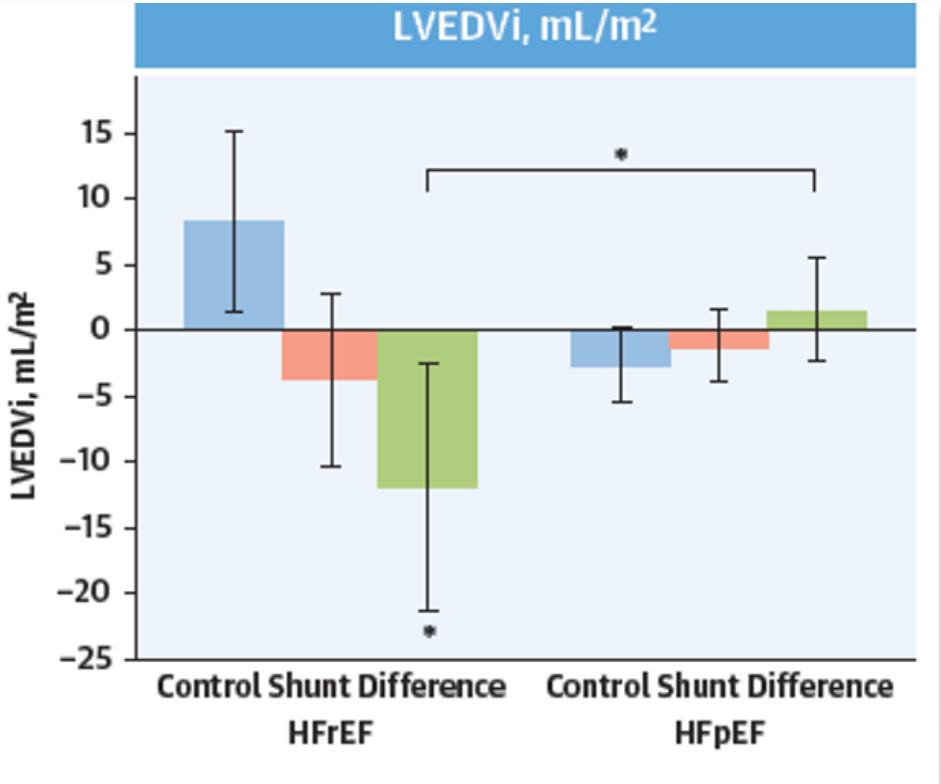
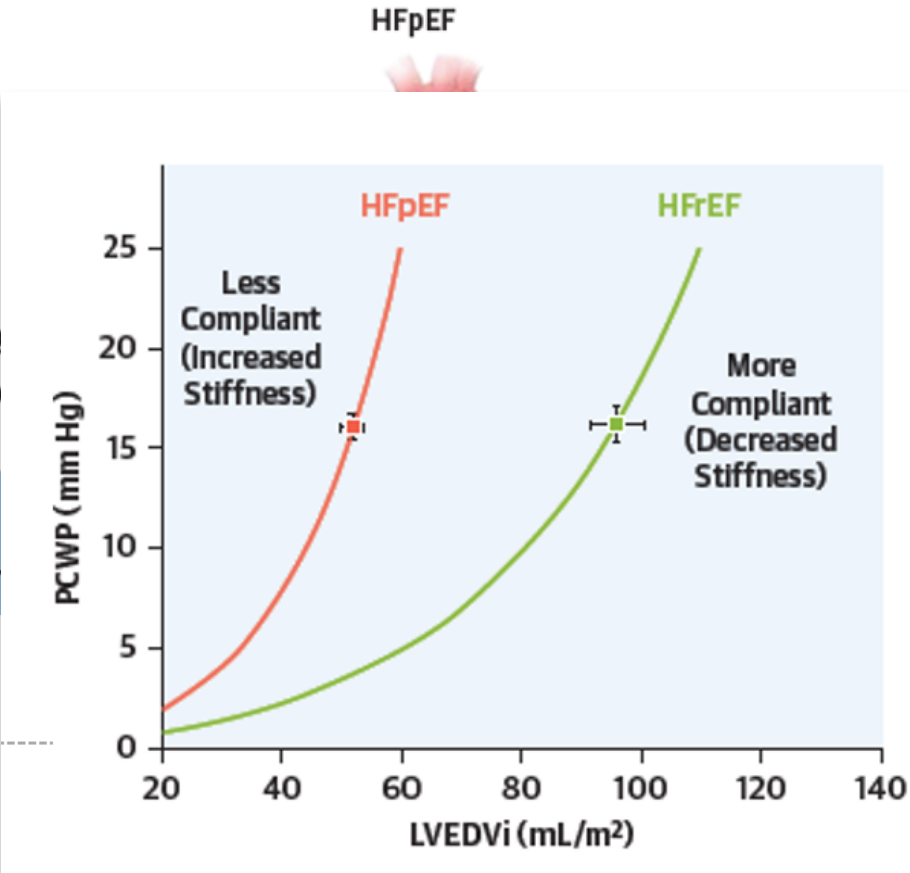
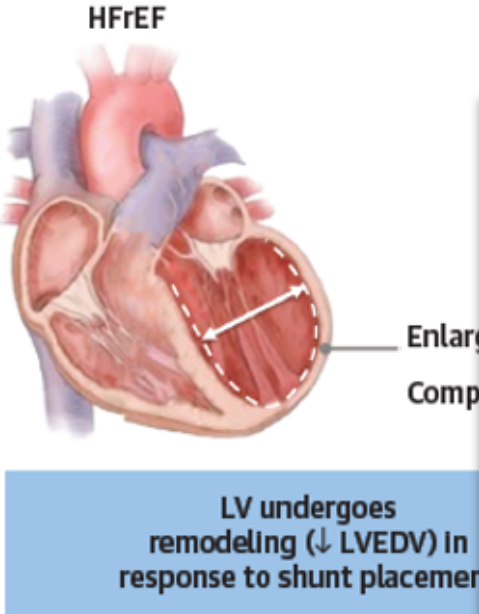
N at Risk:

Placebo	153	153	150	138	93	72	31
Shunt	149	148	140	127	102	77	41

Stone GW et al. Circulation. 2024;150:1931-43

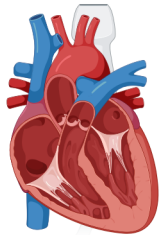


Differences in LV Structure and Function Affect Responses to Interatrial Shunt



Clinical case: AFR in HFrEF with advanced monitoring

- **Male, 75 years old**
- **CV risk factors:** arterial hypertension, former smoker, obesity.
- **Comorbidities:** Hyperthyroidism; former lymphoma; sleep apnea syndrome; rectal polyposis
- **CV history:** CCS previously treated with CABG (LIMA>LAD; SVG>M1; SVG>RCA) and PTCA; severe MR treated with TEER; permanent atrial fibrillation



2012

**CABG (LIMA>LAD;
SVG>M1; SVG>RCA)**

**Cardiac MRI: severe LV
dysfunction and dilatation
(EF 33%)**



2021

CRT-D implantation

2022

**Atrial fibrillation & severe
MR**



2022-2025

Multiple hospitalization for HF

2026

M-TEER



Clinical findings

M-TEER: Successful with reduction to mild MR

NYHA: Class III

NTproBNP: 1994 ng/L

Medical therapy

- **Sacubitril/valsartan:** 97.2/102.8 mg BID
- **Metoprolol:** 100 mg BID
- **Eplerenone:** 25 mg OD
- **Dapagliflozin:** 10 mg OD
- **Vericiguat:** 5 mg OD
- **Furosemide:** 75 mg OD
- **Apixaban:** 5 mg 1cx2 OD



Echo findings

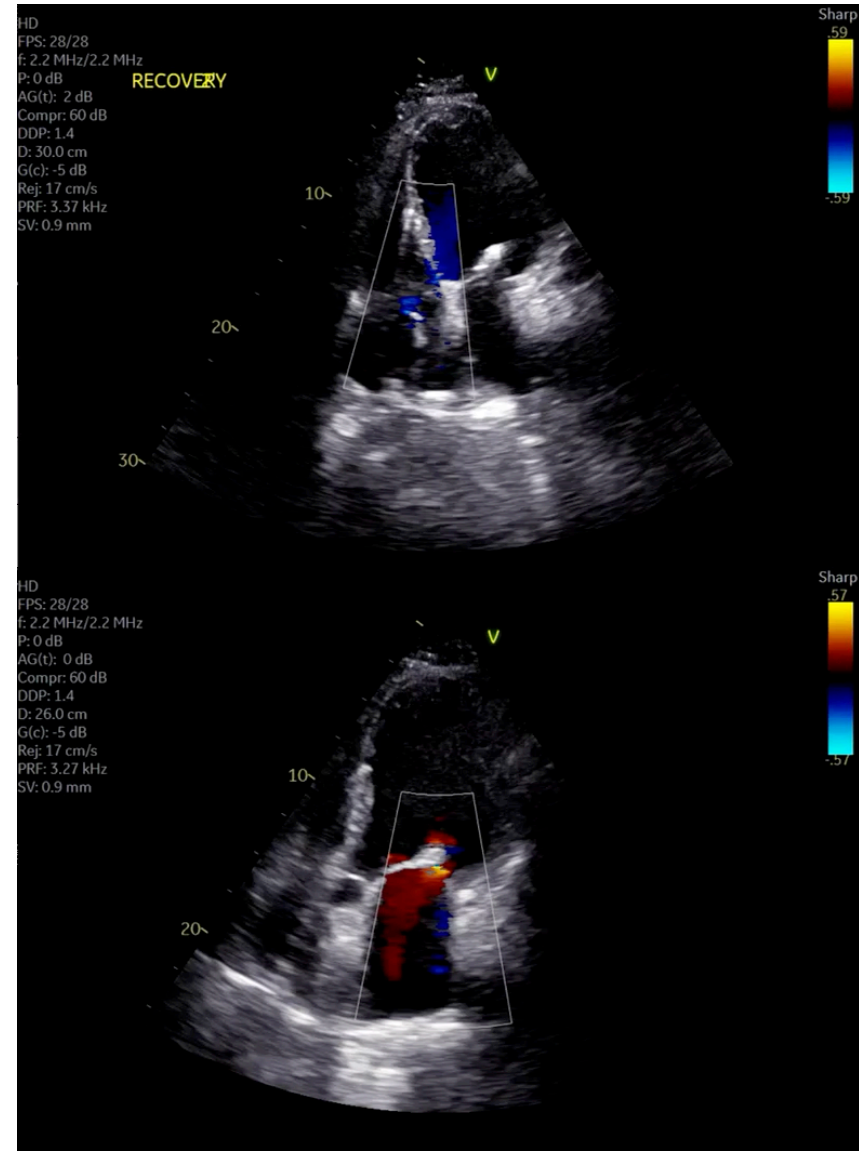
LV Function: Severe dysfunction (EF 30%)

Right Heart: Preserved (TAPSE 17mm, S'12)

PAPs: 40 mmHg

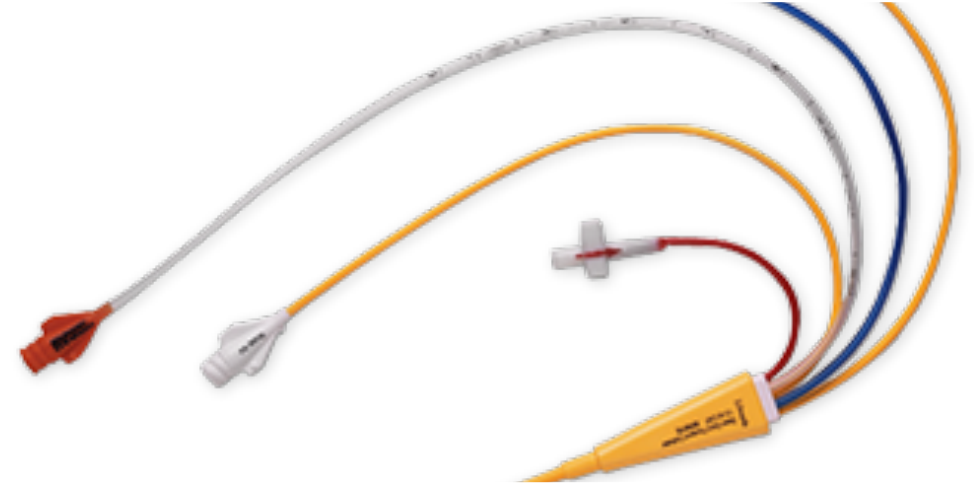
TAPSE/PAPs: 0.43

Mild Mitral Regurgitation post M-TEER, mean gradient 3 mmHg



Right heart catheterization

- **Right Atrial Pressure:** 8 mmHg
- **Right Ventricular Pressure:** 45/11 mmHg
- **Pulmonary Artery Pressure:** 45/20 mmHg (Mean: 30 mmHg)
- **PCWP:** 20 mmHg
- **PVR:** 2,7 W.U.
- **Cardiac Output:** 4.53 L/min
- **Cardiac Index:** 2.2 L/min/m²



Conclusions

- Mild post pulmonary hypertension
- Reduced cardiac index



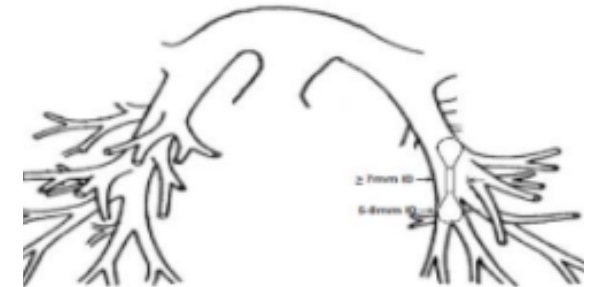
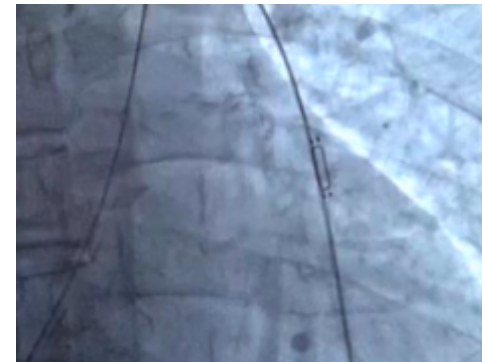
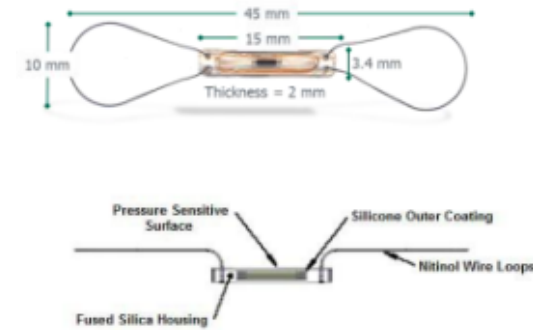
CardioMEMS

Allow a continuous monitoring of **arterial pulmonary pressure**

- **Baseline PCWP:** 20 mmHg
- **sPAP/dPAP/mPAP:** 45/20/30 mmHg
- **Cardiac Output:** 4.53 L/min

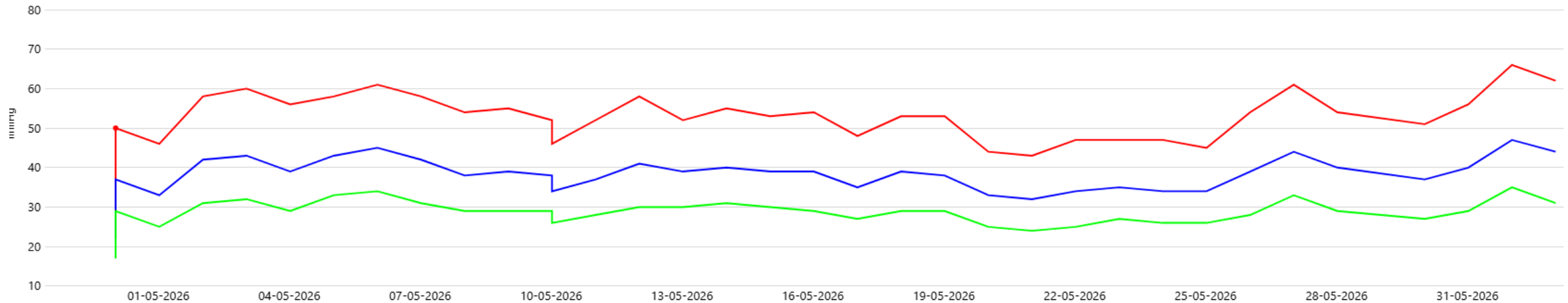
Titration of medical therapy

- **Furosemide:** 125 mg OD
- **Acetazolamide:** 250 mg (3 x week)



After implantation CardioMEMS revealed **increased PAP despite diuretic escalation**

Clinical Status: patient remained in **NYHA III** with further worsening in last week



Latest Data: 02/06/26

sPAP/dPAP/mPAP

62/31/44 mmHg

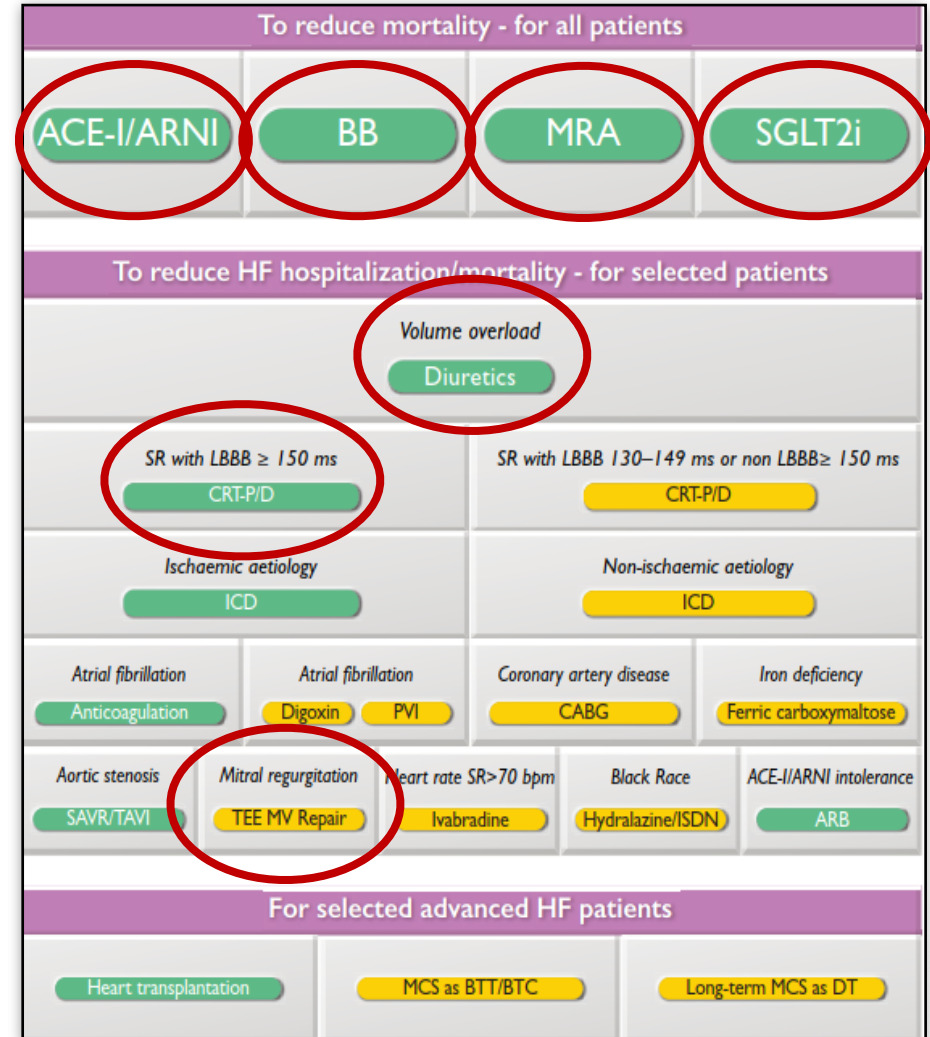
Therapy Adjustment: Sacubitril/Valsartan reduced to 49/51 BID

Reason: Recurrent Hypotension episodes



What are the alternatives for HF patients doing poorly on GDMT and persistently high mPAP?

Therapeutic Focus



Interatrial Shunt - KnowHow at FTGM-CNR



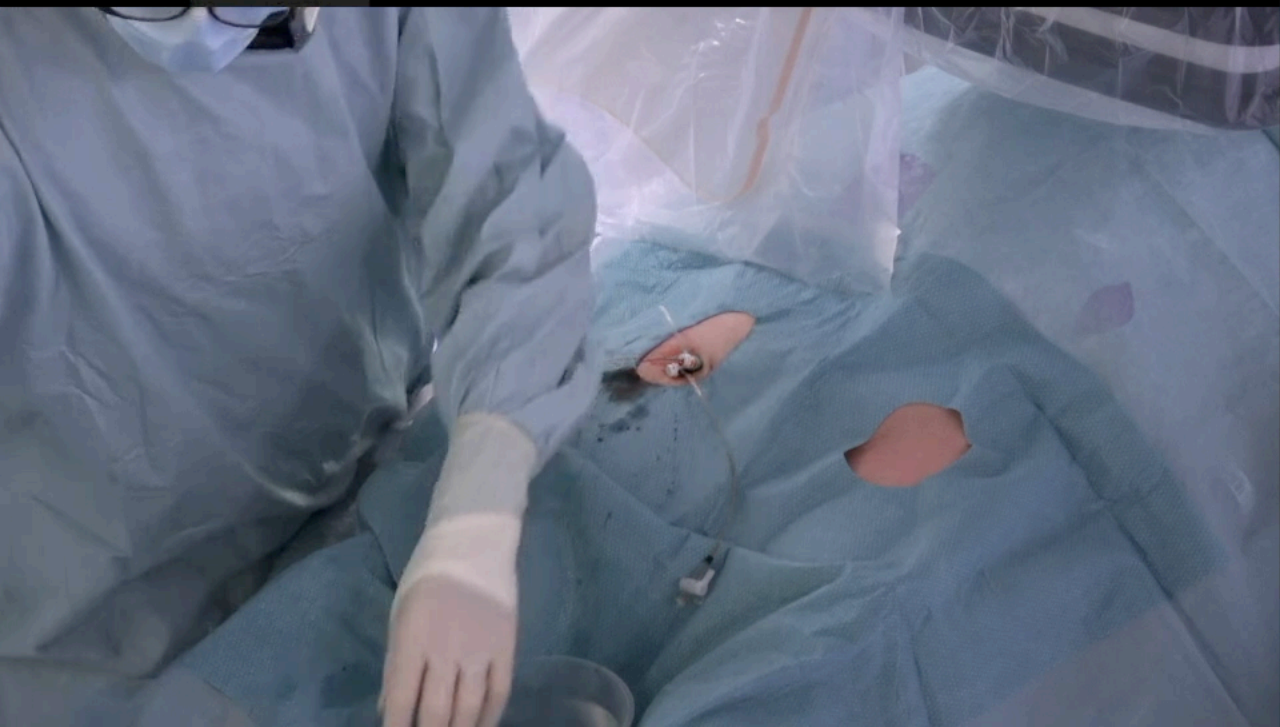
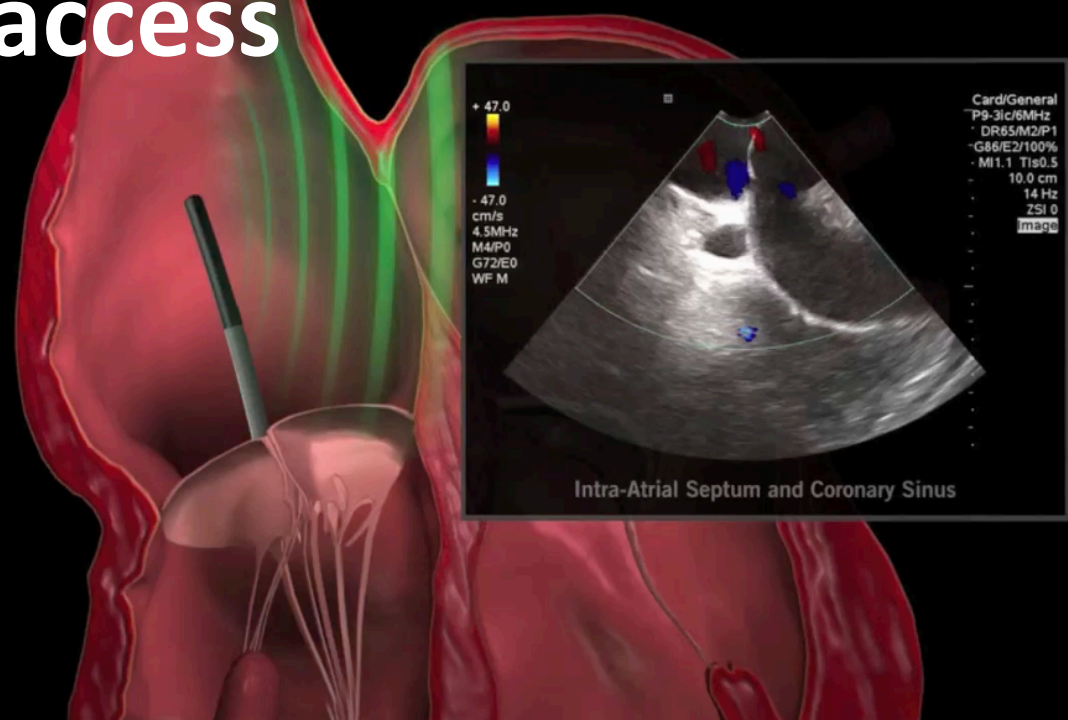
Intracardiac Echocardiography–Guided Atrial Flow Regulator Implantation for Heart Failure

Luigi Pastormerlo, MD, PhD,^a Francesco Orazi, MD,^b Eliana Carapellucci, MD,^c Yu Fu Ferrari Chen, MD,^c Massimiliano Mariani, MD,^a Andreina D'Agostino, MD,^a Giovanni Benedetti, MD, PhD,^a Giuseppe Santoro, Sergio Berti, MD^a

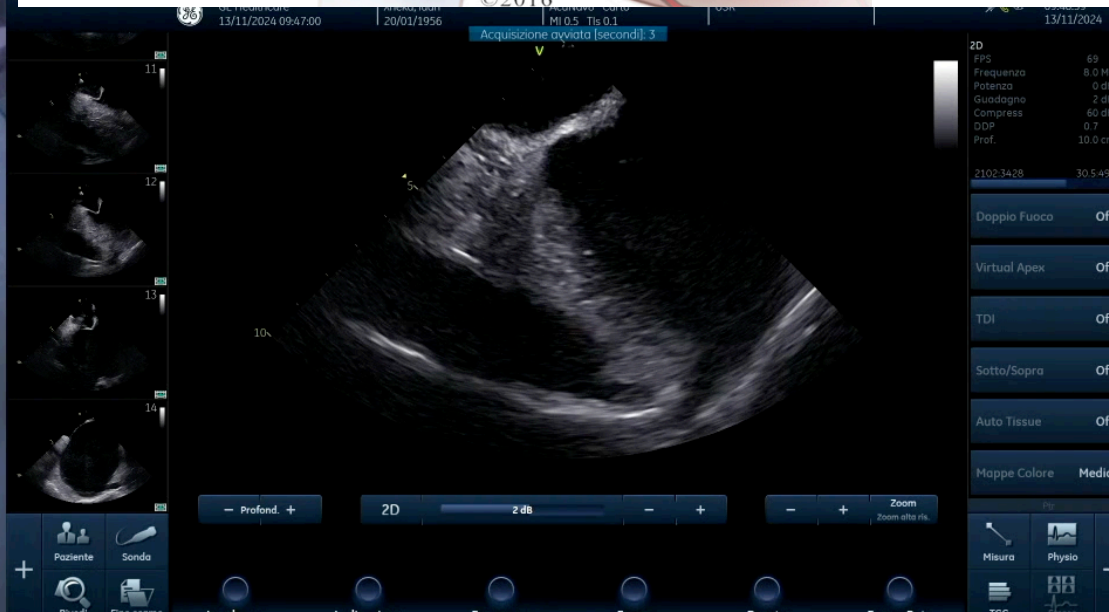
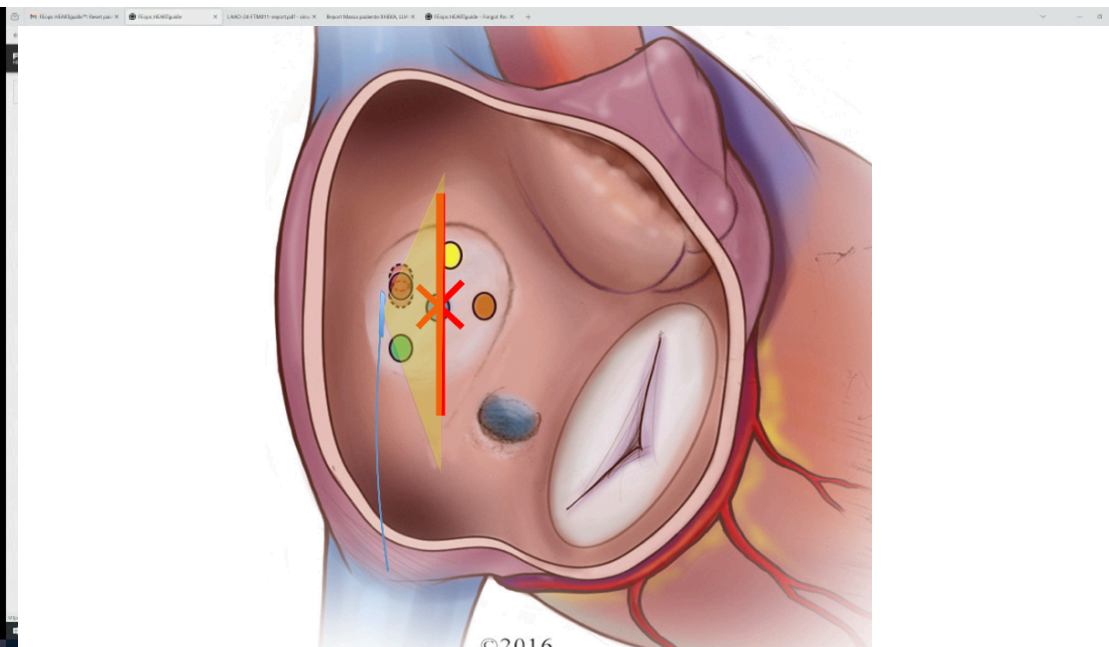
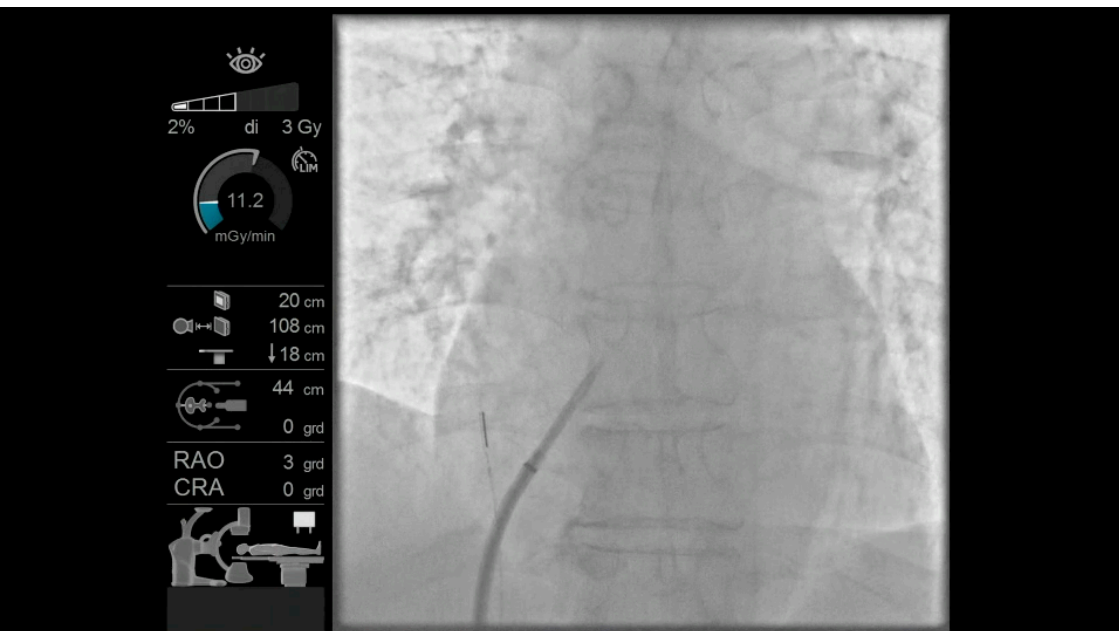
- General anesthesia not required
- Cath lab quick turnover
- Allows for continuous imaging without interfering with fluoroscopy
- Clear images of the: IA Septum, AFR-device and position



Single groin- Double Vascular access

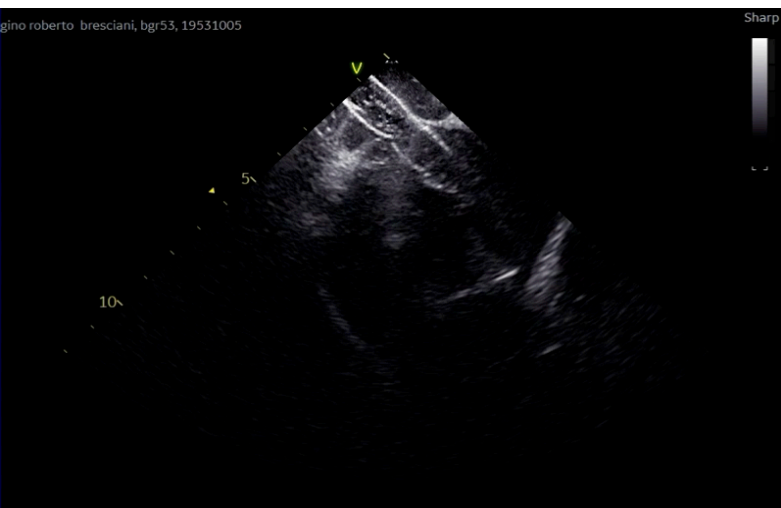
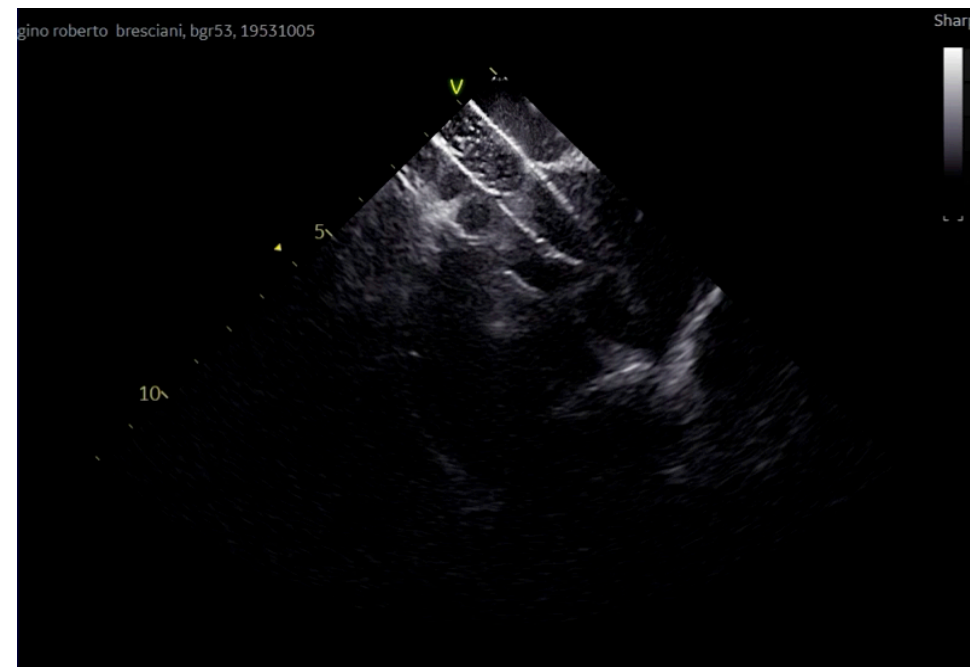


TRANSSEPTAL PUNCTURE



SEPTUM PREPARATION

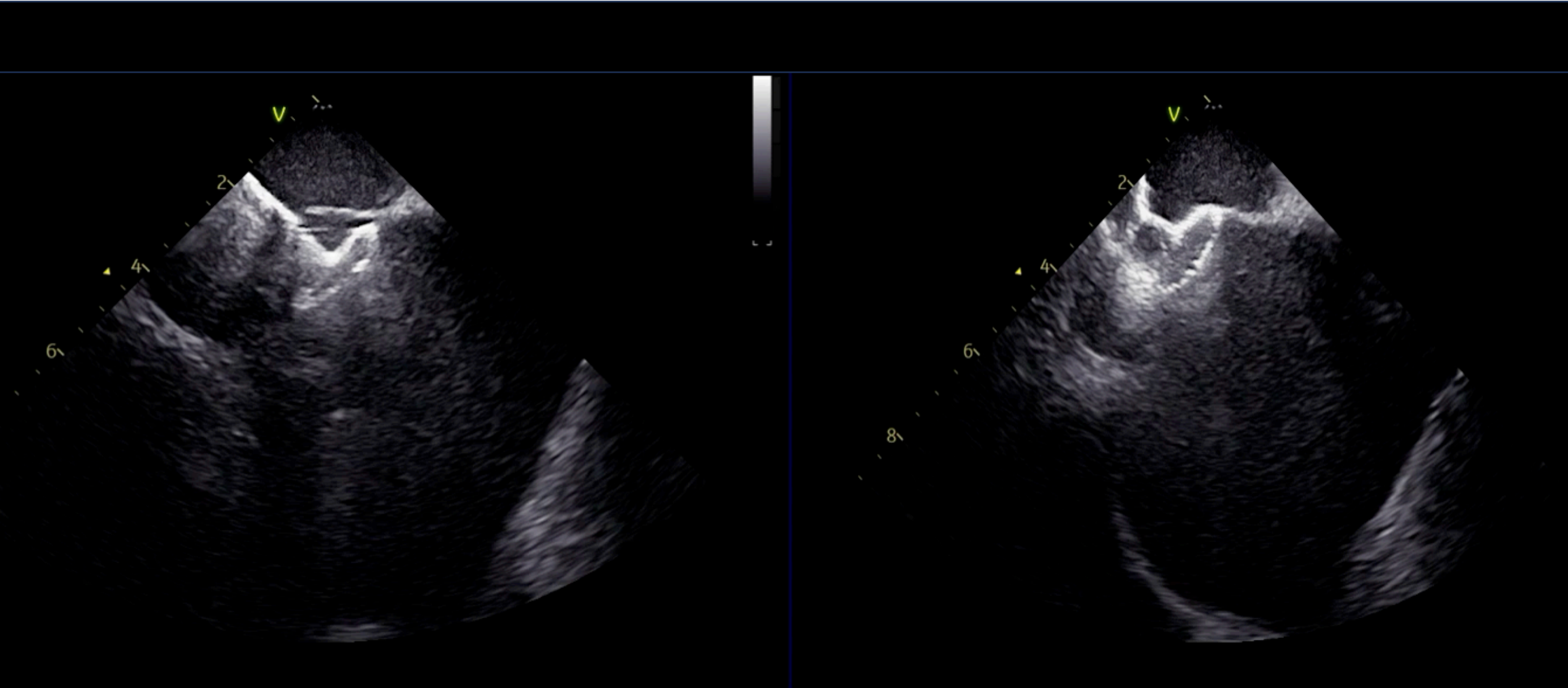
Balloon (12x40 mm) dilatation of TSP



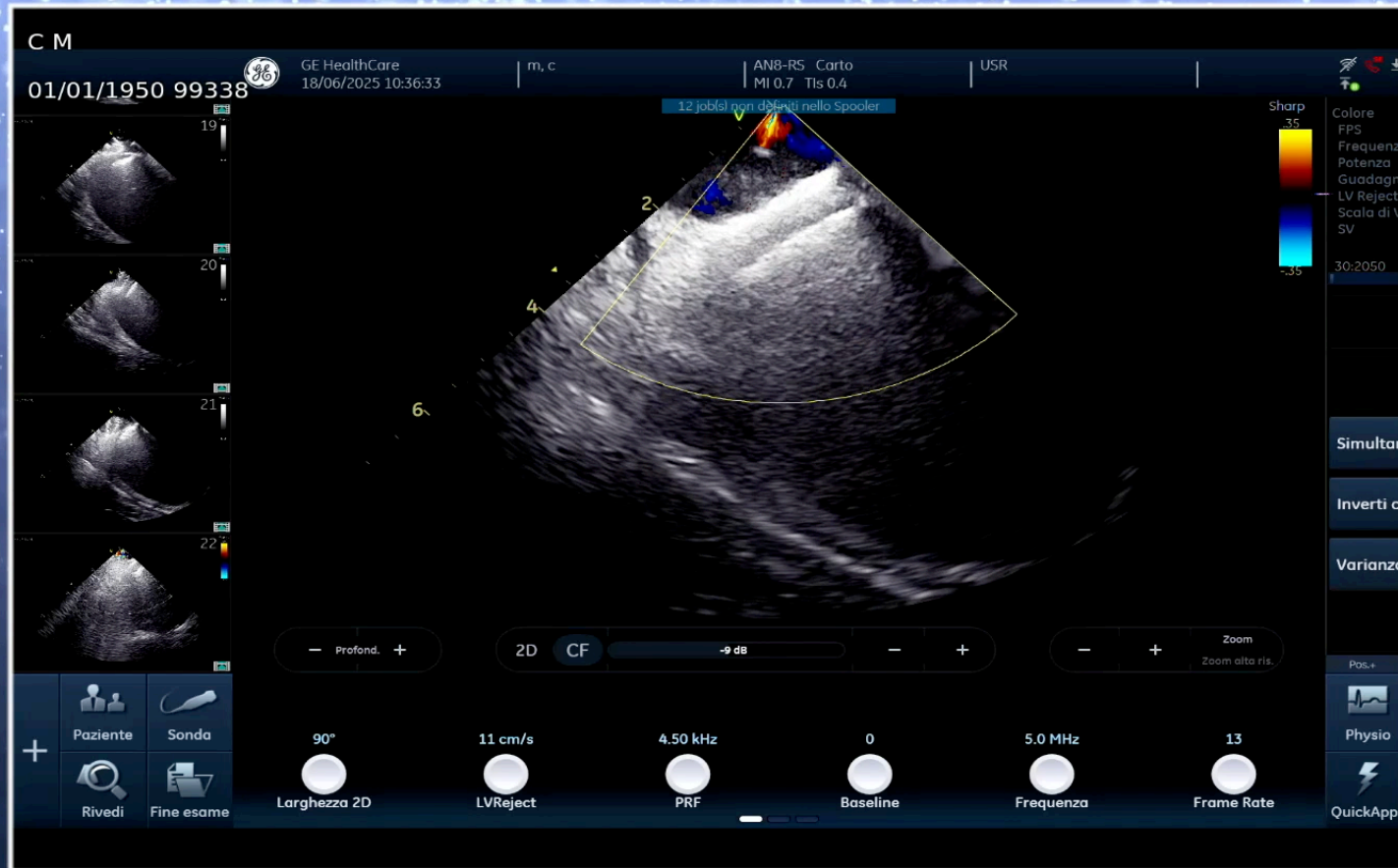
DEVICE DEPLOYMENT

Left atrial disc

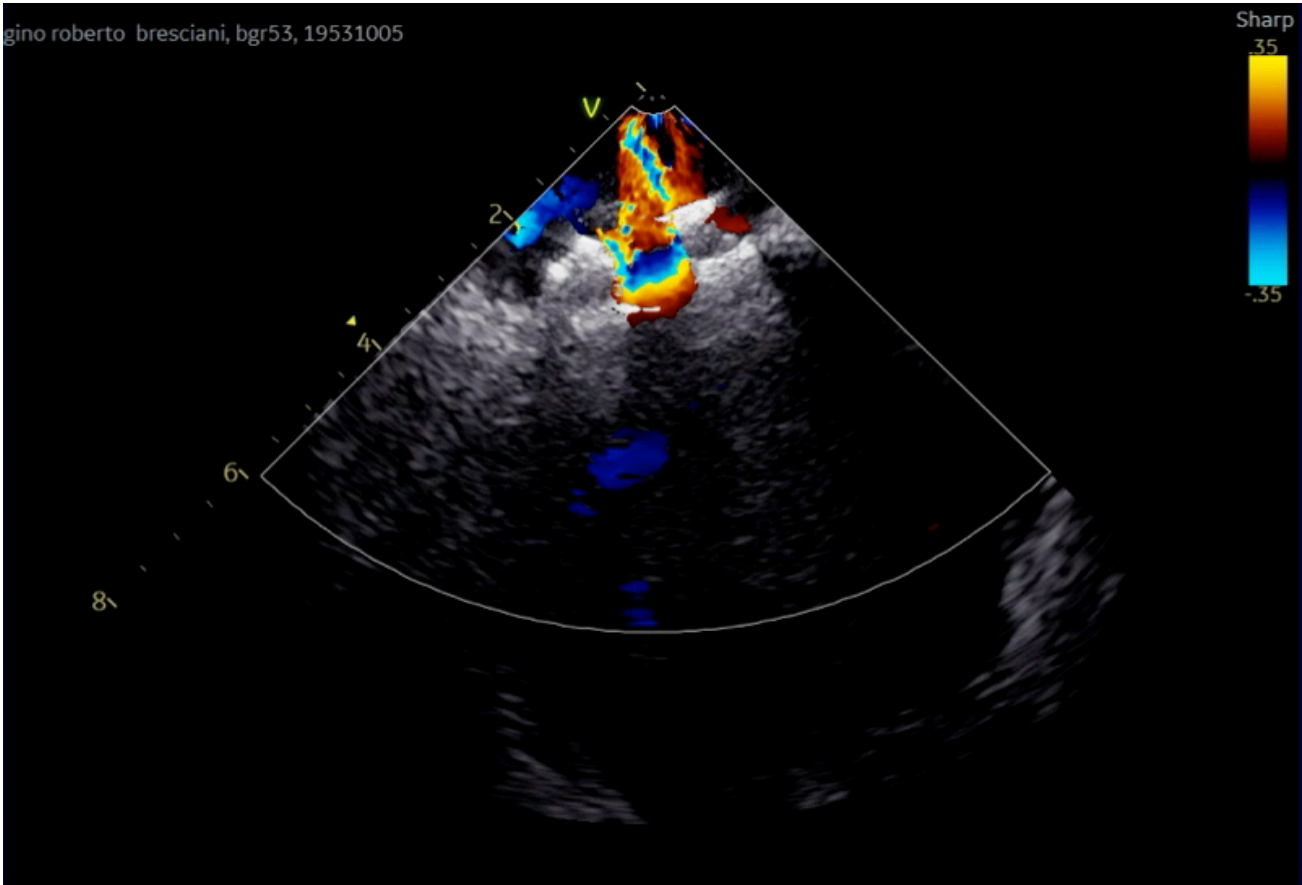
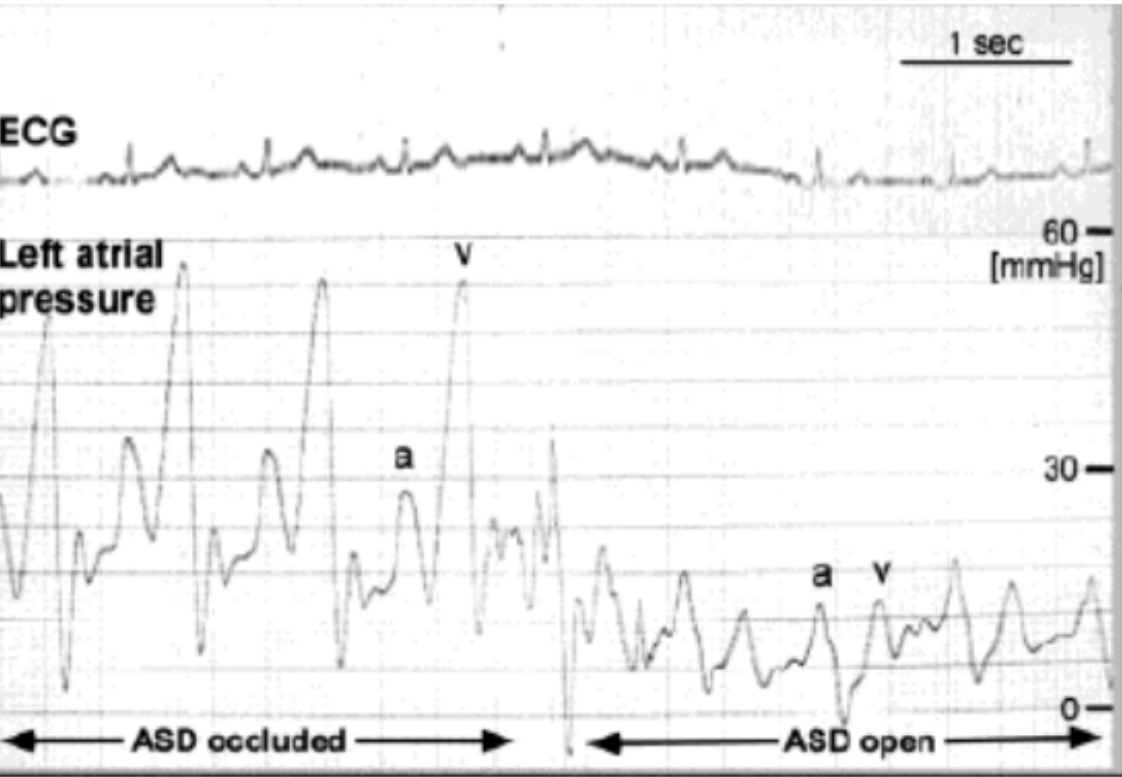
Right atrial disc



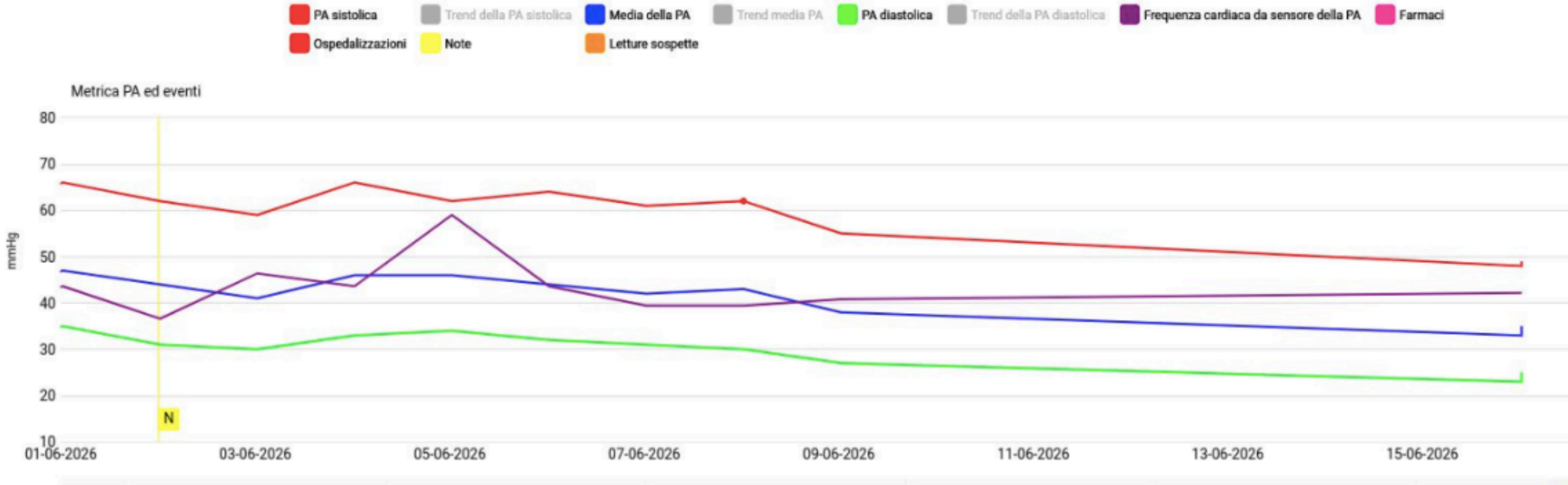
Device Release under ICE/Fluoro Guidance



Assessment of pressures in the right-sided chambers post AFR implantation



Two weeks later...



02/06/26 AFR implant

sPAP/dPAP/mPAP

62/31/44 mmHg **NYHA III**



15/06/26

sPAP/dPAP/mPAP

48/23/33 mmHg **NYHA II**



Key Inclusion Criterias

- ✓ HFrEF patients
- ✓ PCWP at rest ≥ 15 mmHg
or
- ✓ PCWP under exercise ≥ 25 mmHg
- ✓ LVEF $\geq 15\%$
- ✓ LVEF $> 40\%$ (HFpEF),
- elevated NT-pro-BNP of ≥ 125 pg/ml
- ✓ Left Atrial Pressure (LAP) $>$ Right Atrial Pressure (RAP)
- ✓ Ongoing management of HF according to ESC guidelines during previous 6 months
- ✓ Life expectancy of at least 1 year

Key Exclusion Criterias

- × Right heart failure defined as (by ECHO) TAPSE < 14 mm or PASP > 60 mmHg
- × Severe tricuspid regurgitation
- × Intracardiac thrombus
- × Systolic blood pressure of > 170 mmHg, despite medical therapy
- × Uncontrolled arrhythmia
- × History of ASD and/or PFO repair or closure device in place
- × TIA or stroke within the last 6 months
- × Hypertrophied Inter Atrial Septum > 10 mm depth
- × Hypertrophic Obstructive Cardiomyopathy or infiltrative CM as cause of HF

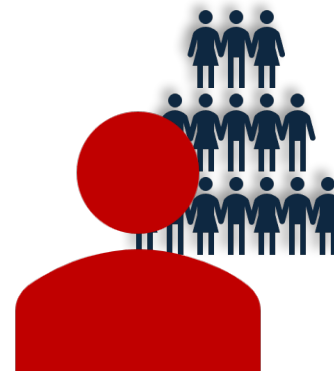


- ✓ Heart Failure (HFrEF) refractory or symptomatic despite optimal medical therapy and possible interventional alternatives
- ✓ Acute heart failure event (eg. hospitalization)
- ✓ Dyspnea – NYHA class III
- ✓ Progressive NT-proBNP increase / diuretics dosage
- ✓ Progressive physical limitation (CPET/6MWT)
- ✓ Right section functionality preserved

Invasive cardiac catheterization and haemodynamic measurements:

+ PCWP or LVEDP $\geq$ 15 mmHg or

+ PCWP $\geq$ 25 mmHg at exercise and CVP $<$ 20 mmHG



- **We have an idea of how it works**
- **Clinical observation and pre-clinical/early clinical studies suggest why it should work**
- **However, it doesn't work for everybody:**
 - *A prespecified analysis of RELIEVE-HF suggests shunting is beneficial in HFrEF and worsens outcomes in patients with advanced HFpEF*
 - *A post-hoc analysis of REDUCE LAP-HF II suggests interatrial shunting may be beneficial in some HPpEF patients*



Shunt interatriale come nuova frontiera nel trattamento dello scompenso cardiaco

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