Heart Failure with Preserved Ejection Fraction (HFpEF)

- Definition and Aetiology
- Diagnostic challenges
- Management and Prognosis

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- Clinical Presentations
- Definition
- Epidemiology
- Therapy
  - Prevention
  - Treatment
- Novel developments

Clinical Presentation - I

F80

C/o Progressive SOB for 1 yr, PND

PH of HT, DM

Bilateral basal crackles

Investigations

CXR: pulmonary congestion

ECG: SR + LVH

⇧ BNP

Echo: LVH
LVEDD 3.5cm (N 3.5 -5.0)
LVEF 80%
LA dimension (4.5cm)
RVSP 50 mmHg
E/e' 20

Classical HFpEF

Clinical Presentation – II (1)

Clinical Features

M/60 Progressive exertional dyspnoea

No PND, No orthopnoea, Well controlled HT

BMI 32

No lung crackles, BP 140/70

Investigations

Normal CXR + lung function test

ECG: SR, borderline LVH

BNP: Normal

Echo: EF 60%, LVEDD 5cm, LA 4cm

E/e', E/A borderline, RVSP normal

MRI heart: No ischemia, no infiltration

Clinical Presentation – II (2)

Right heart catheterisation:

	Resting	Leg elevation
RAP	5	18
PAP	30 / 10	50 /10
PCWP	10	30 (Giant V wave)

Remarks: BNP normal in obesity due to ⇩production and ⇧clearance

Early HFrEF or distinct presentation

Definition of HFpEF

ESC 2016

1. HF S/S
2. LVEF ≥50% (HFmrEF: LVEF 40 – 49%)
3. ⇧BNP ≥ 35 pg/ml or ⇧ProBNP ≥ 125 pg/ml
4. ≥ 1 additional criterion
   a) SHD & LVH
      ① LVMI > 115 g/m^2 for men and ≥ 95g/m^2 for women
      ② LAVI > 34 ml/m^2
   b) Evidence of DD
      ① E/e' > 13
      ② Mean e' (s + l) < 9 cm/s
      ③ Raised RVSP (>2.8 m/s)

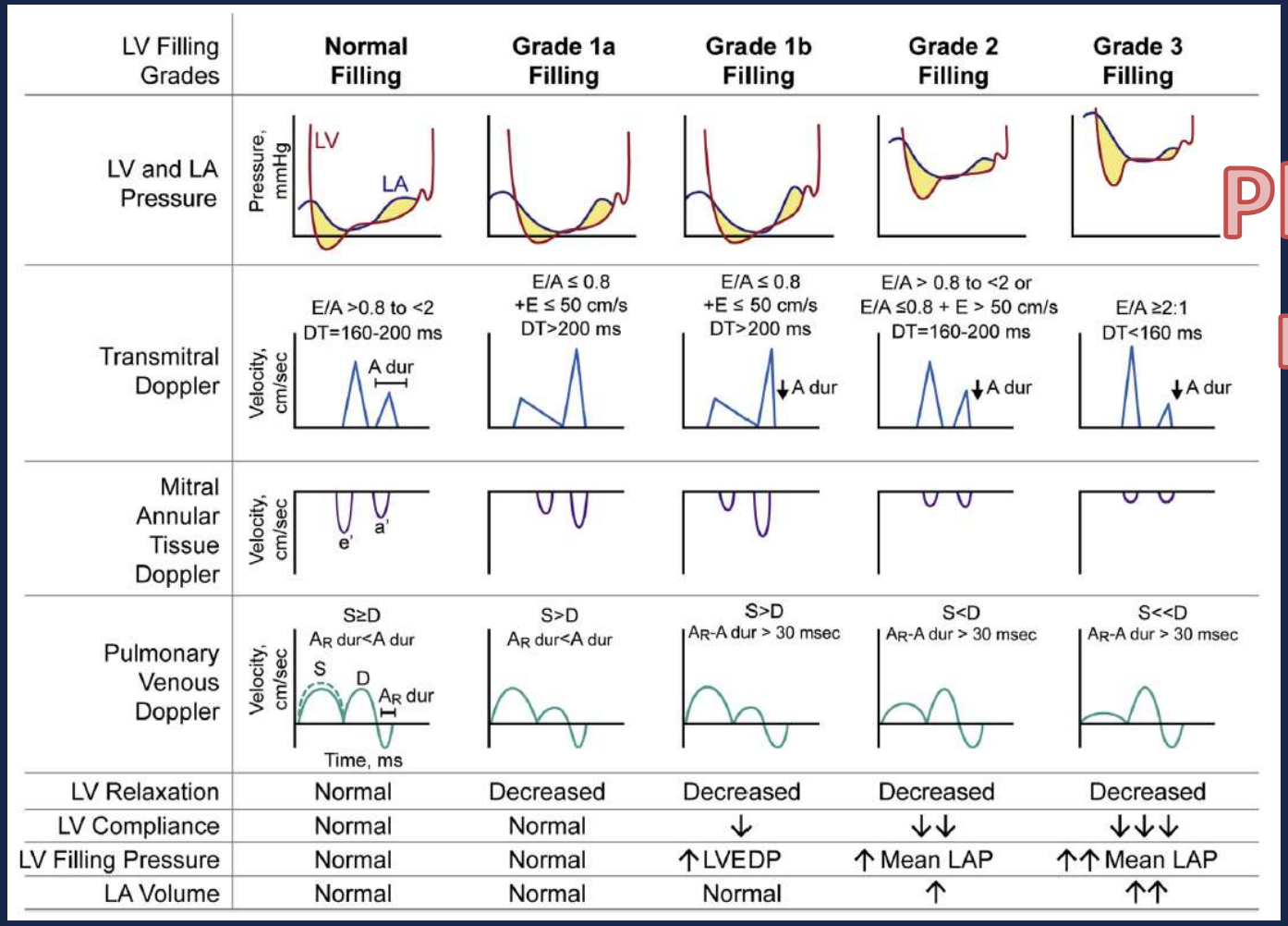
AHA/ACC/HFSA 2017 Definition:
HF S/S; LVEF > 40% & DD

Ddx of HFpEF from SHD: Dyspnoea

Dunlay SM et al. 2017, Mayo Clinic Proc. Nature Review

1. Uncorrected left side VHD
   - AS, AR, MS, MR
2. Isolated R heart failure
   - PAH, ARVD, CHD, TVD, RV infarct
3. Pericardial disease
   - Tamponade, constrictive pericarditis
4. Specific cardiomyopathies
   - Infiltrative (amyloid), Infections/ inflammatory (sarcoid, viral)
5. Genetic
   - HCM, Restrictive
6. Non-CVS causes
   - Systemic illness (High output HF)
   - RAS (recurrent ADHF, borderline RFT, PAD)

Echo-Doppler Indices of Diastolic Dysfunction

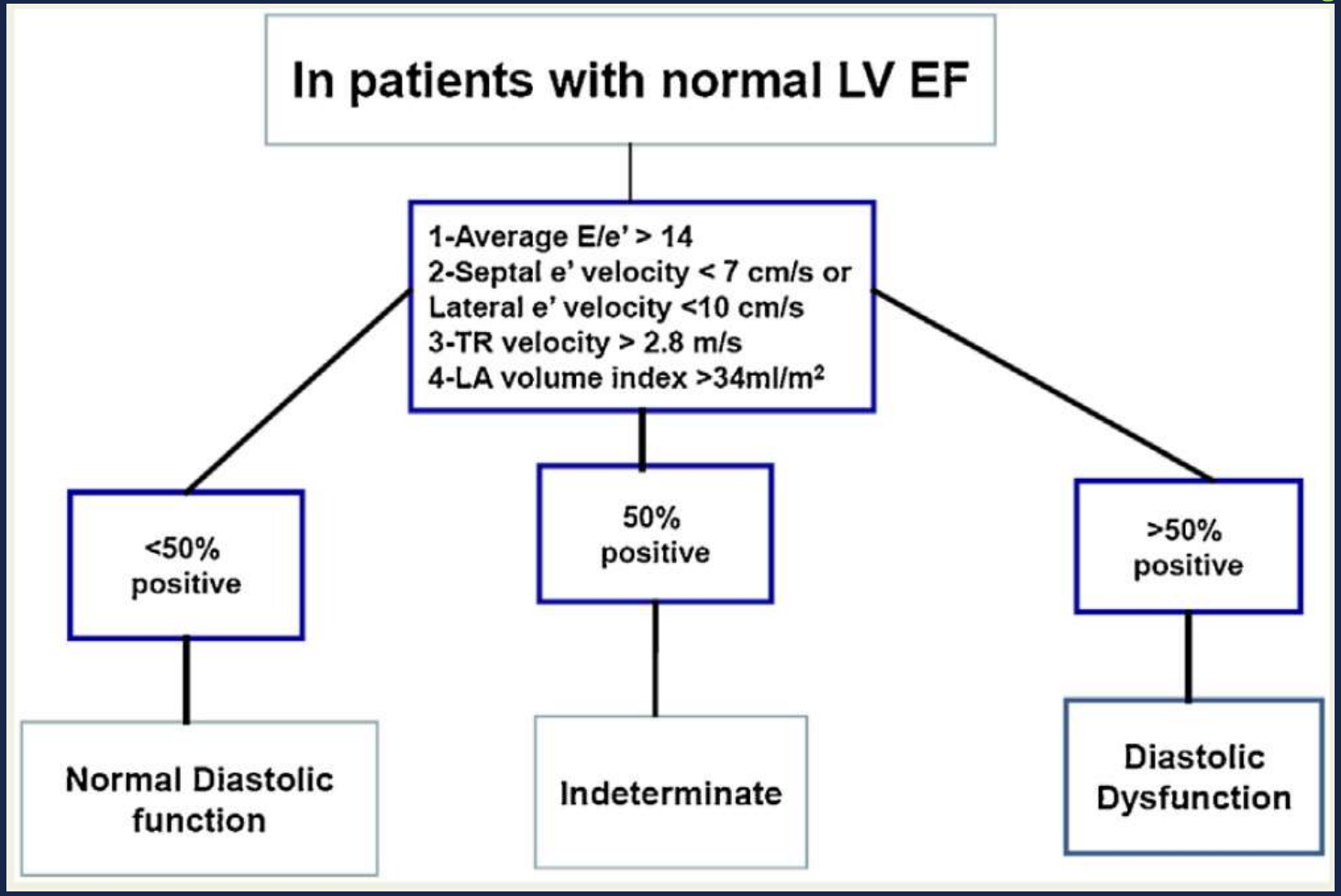


Please read

ESC 2016 HF Guideline: Web-table for DD

Parameter	Normal diastolic function						Diasto[illegible] function		
	20–40 years		40–60 years		≥60 years		[illegible]mpair[illegible] relaxa[illegible]	Pseudo-normal [illegible]lling	Restrictive filling
	Male	Female	Male	Female	Male	F[illegible]ale			
MV-inflow									
MV-E (m/s)	0.79 ± 0.14	0.84 ± 0.17	0.72 ± 0.16	0.7[illegible] 0.[illegible]	[illegible]7 ± 0	0.72 ± 0.17			
MV-A (m/s)	0.50 ± 0.13	0.51 ± 0.[illegible]	0.6[illegible] [illegible]5	[illegible]63 [illegible]0.14	0.[illegible]3 ± 0.16	0.76 ± 0.16			
DecT (m/s)	179.8 ± 46.4	176.7 [illegible]40	18[illegible] ± 52.8	[illegible]8.2 ± 39.8	217.5 ± 69.7	201.5 ± 55.7	>220	140–220	<140
E/A ratio (m/s)	1.69 ± 0.[illegible]	1.72 ± [illegible]2	[illegible]2 ± 0.31	1.26 ± 0.43	0.96 ± 0.27	[illegible]9 ± 0.31	<1.0	1.0–2.0	>2.0
Ivrt (m/s)							>110	60-100	<60
Tissue Doppler									
e' septal (cm/s)	11.9 ± 2.7	12.3 ± 2.3	9.8 [illegible]	[illegible]	7.3 [illegible]	7.9 ± 2.3	<8	<8	<8
e' lateral (cm/s)	16.2 ± 3.6	16.6 ± 3.2	[illegible]6 ± 3.0	1[illegible] ± 3	[illegible].5 ± 2	9.7 ± 3.2	<10	<10	<10
e' mean sept-lat (cm/s)	14.0 ± 2.9	14.5 ± 2.4	1[illegible] ± 2.4	11.[illegible] ± 2.5	8.5 ± 1.9	8.8 ± 2.6			
E/e' septal	6.9 ± 1.7	6.9 ± 1.6	7.8 ± 2.4	8.2 ± 2.2	9.8 ± 3.0	9.7 ± 2.6			
E/e' lateral	5.0 ± 1.3	5.2 ± 1.3	6.1 ± 2.2	6.5 ± 2.3	7.6 ± 2.1	7.9 ± 2.2			
E/e' mean sep-lat	5.8 ± 1.4	5.9 ± 1.3	6.7 ± 2.1	7.2 ± 2.0	8.4 ± 2.2	8.6 ± 2.2		≥13	≥13

2016 ASE/EACVI Guideline for DD in HFpEF



Prasad SB et al. Heart, Lung and Circulation 2019, in press.

Caveats of Measuring DD

Silbiger JJ. J Am Soc Echo 2019;32:216-32

1. Sinus bradycardia or HR > 90-100 bpm
2. First degree HB, LBBB and Pacing (RV or BV)
3. MVD (MR, MS, Annular calcification, MVR)
4. AF, HCM
5. High output heart failure
6. Pericardial disease

Evidence of Raised LA pressure in AF

Silbiger JJ. J Am Soc Echo 2019;32:216-32

1. E/e' (septal) ≥ 11 (average of 10 cycles)
2. 'Fixed' E velocity at varying CL
3. IVRT < 60ms
4. DT for E < 160ms in the presence of depressed LVEF

US Epidemiology & Risk Factors of HFpEF

- In the US, 2-4% of population have HF
- About half due to HFpEF, and which will increase relative to HFrEF over time
- 12 yrs incidence is age dependent: 7.3% (73yrs); 3.1% (58 yrs); 1.5% (49yrs)
- Decline in sex and age-adjusted HF incidence was less than HFrEF (-28 vs -45%)
- 5 yrs mortality > 50%, 49% cf 36% died of non-CVS causes. SCD rate lower

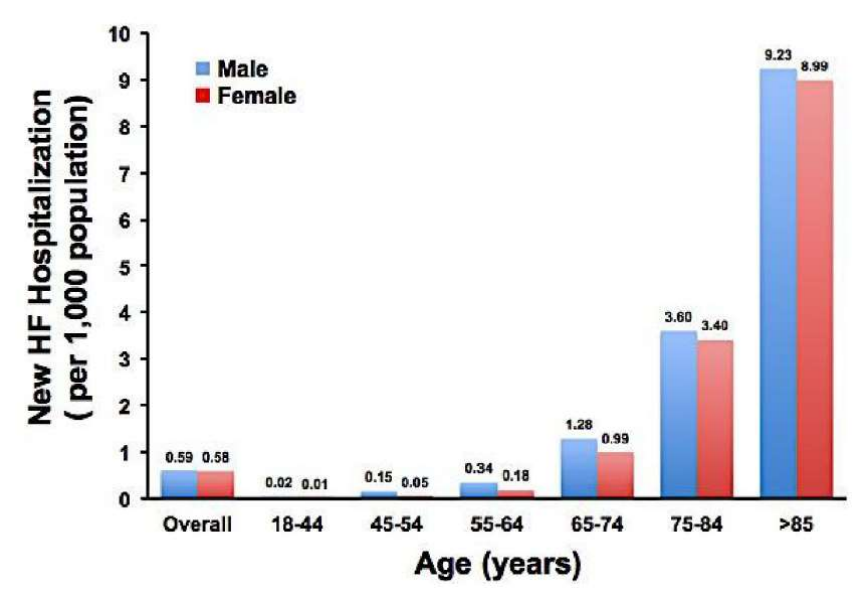
Glaolden JD et al. Annu Rev Med 2018;69:65-79

HF Hospitalised Patients in HK: HK HF Registry

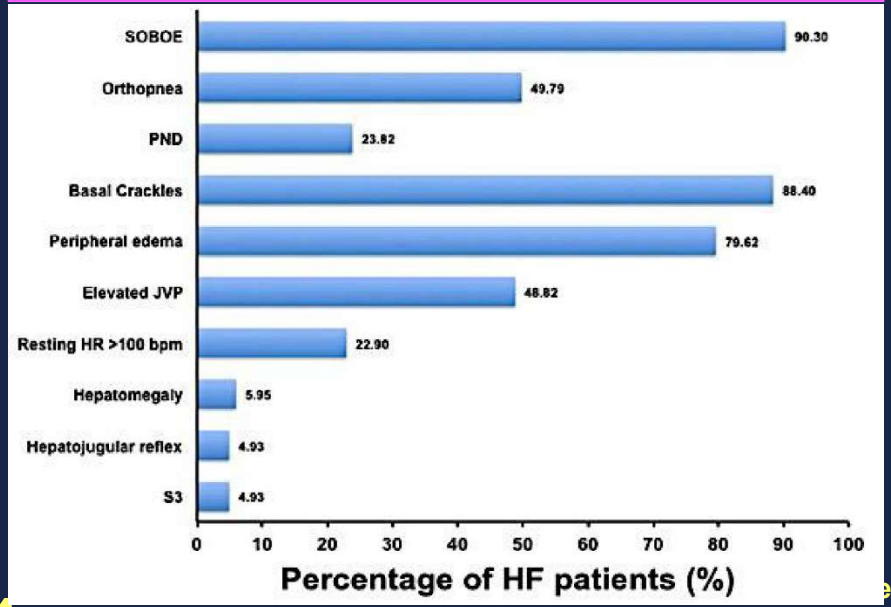
Hai JJ… Lau CP, HF Tse, Siu DCW. J Cardiac Fail 2016;22:600-608 (1)

1,940 pts admitted QMH between 2005 – 2012 with HF diagnosis. Mean age 78 ± 18 yr, 52.4% females. Rate of HFH 0.59/1000 population

Age



Symptoms



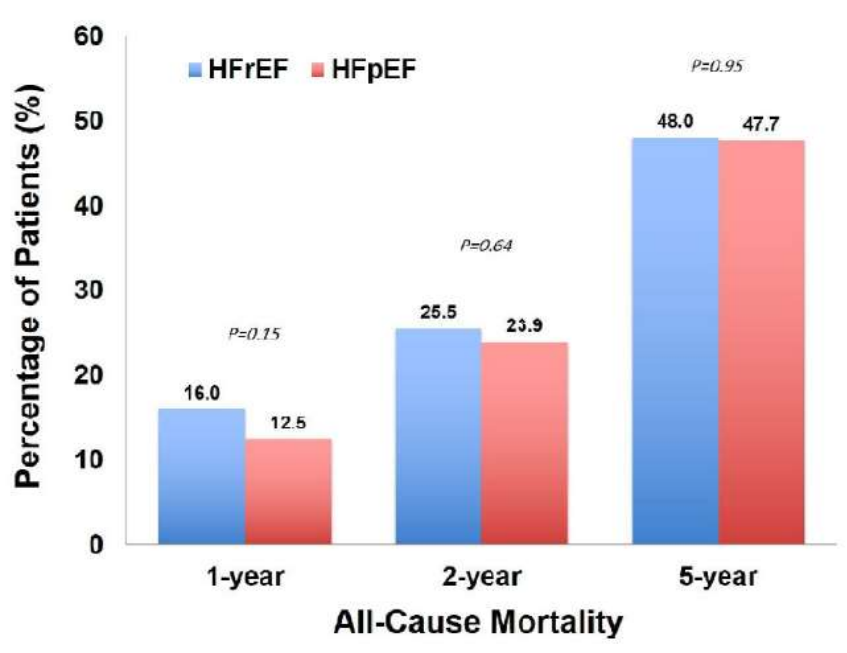
	All (n = 1940)	HFrEF (n = 383)	HFpEF (n = 569)	HFuEF (n = 988)	*P* Value*	*P* Value†
Age, (y)	78.2 ± 11.8	72.2 ± 13.9	76.9 ± 10.7	81.2 ± 10.4	<.001‡	<.001‡
Male, n (%)	888 (45.8)	229 (59.8)	238 (41.8)	421 (42.6)	<.001‡	<.001‡
Hypertension, n (%)	1355 (69.8)	231 (60.3)	409 (71.9)	715 (72.4)	<.001‡	<.001‡
Diabetes mellitus, n (%)	696 (35.9)	138 (36.0)	219 (38.5)	339 (34.3)	.25	.44
Smoker, n (%)						
Current smoker	176 (9.1)	63 (16.4)	48 (8.4)	65 (6.6)	<.001‡	<.001‡
Ex-smoker	401 (20.7)	83 (21.7)	90 (15.8)	228 (23.1)	.003‡	.02‡
Drinker, n (%)						
Current drinker	93 (4.8)	27 (7.0)	25 (4.4)	41 (4.1)	.07	.08
Ex-drinker	157 (8.1)	32 (8.4)	41 (7.2)	84 (8.5)	.65	.51
Coronary artery disease, n (%)	569 (29.3)	131 (34.2)	140 (24.6)	298 (27.4)	.004‡	.001
Previous myocardial infarct, n (%)	104 (5.4)	31 (8.1)	18 (3.2)	55 (5.6)	.004‡	.001
Peripheral arterial disease, n (%)	68 (3.5)	18 (4.7)	21 (3.7)	29 (2.9)	.27	.44
Previous atrial fibrillation, n (%)	706 (36.4)	120 (31.3)	229 (40.2)	357 (36.1)	.02‡	.005‡
Previous ischemic stroke/TIA, n (%)	303 (15.6)	35 (9.1)	77 (13.5)	191 (19.3)	<.001‡	.04‡
Renal failure, n (%)	224 (11.5)	34 (8.9)	67 (11.8)	123 (12.4)	.17	.16
Significant valvular heart disease, n (%)	118 (6.1)	27 (7.0)	41 (7.2)	50 (5.1)	.16	.93
Hypertrophic cardiopmyopathy, n (%)	16 (0.8)	1 (0.3)	7 (1.2)	8 (0.8)	.27	.11
Congenital heart disease, n (%)	4 (0.2)	0 (0)	3 (0.5)	1 (0.1)	.12	.16
History of myocarditis, n (%)	1 (<0.1)	1 (0.3)	0 (0)	0 (0)	.13	.22
History of chemotherapy, n (%)	12 (0.6)	1 (0.3)	6 (1.1)	5 (0.5)	.25	.16

Hai JJ JCE 2016

HF Hospitalised Patients in HK: HK HF Registry

Hai JJ… Lau CP, HF Tse, Siu DCW. J Cardiac Fail 2016;22:600-608 (2)

Mortality

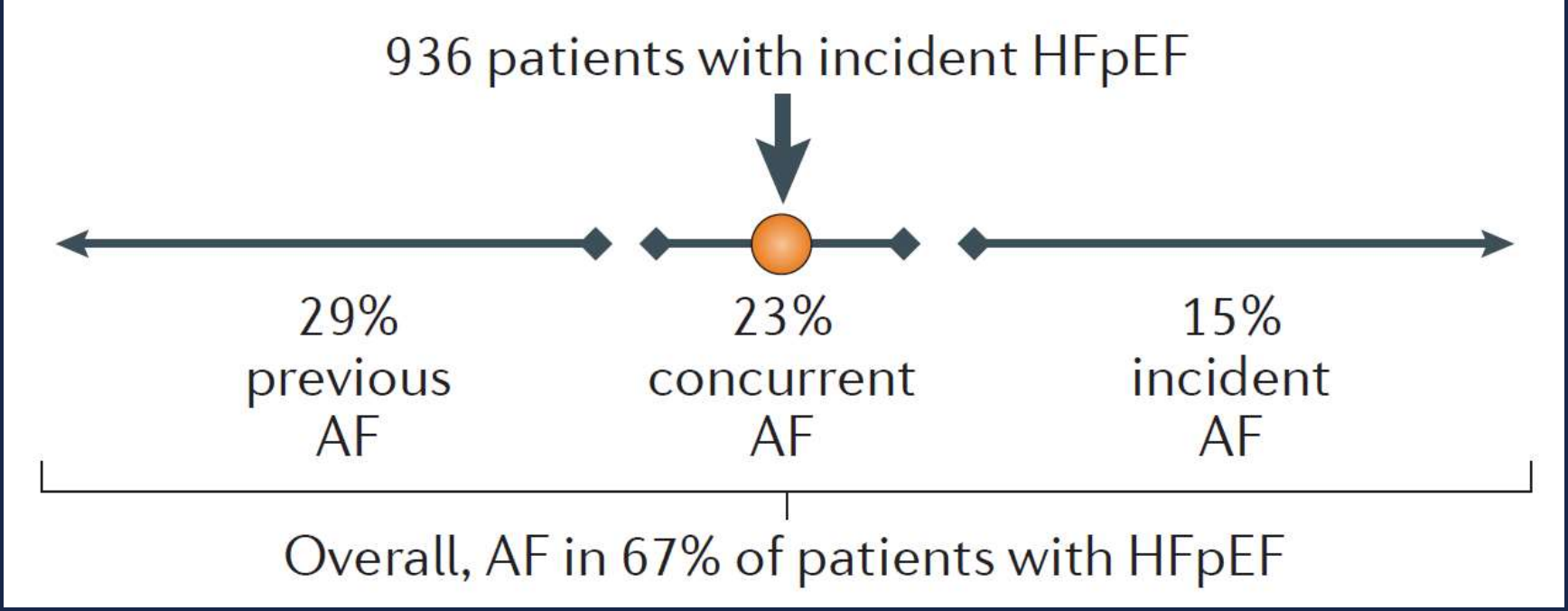


Predictiors of All-cause Mortality

- Age
- Prior MI
- PAD
- AF
- Prior Stroke
- Renal Failure

AF Associated with HFpEF

Reported incidence 15 – 41%



Source: Dunlay SM 2017; Sakeri R 2013

Risk Factors for HFpEF: 2016 ESC

Unavoidable

- Advanced age
- Women

Avoidable & Modifiable

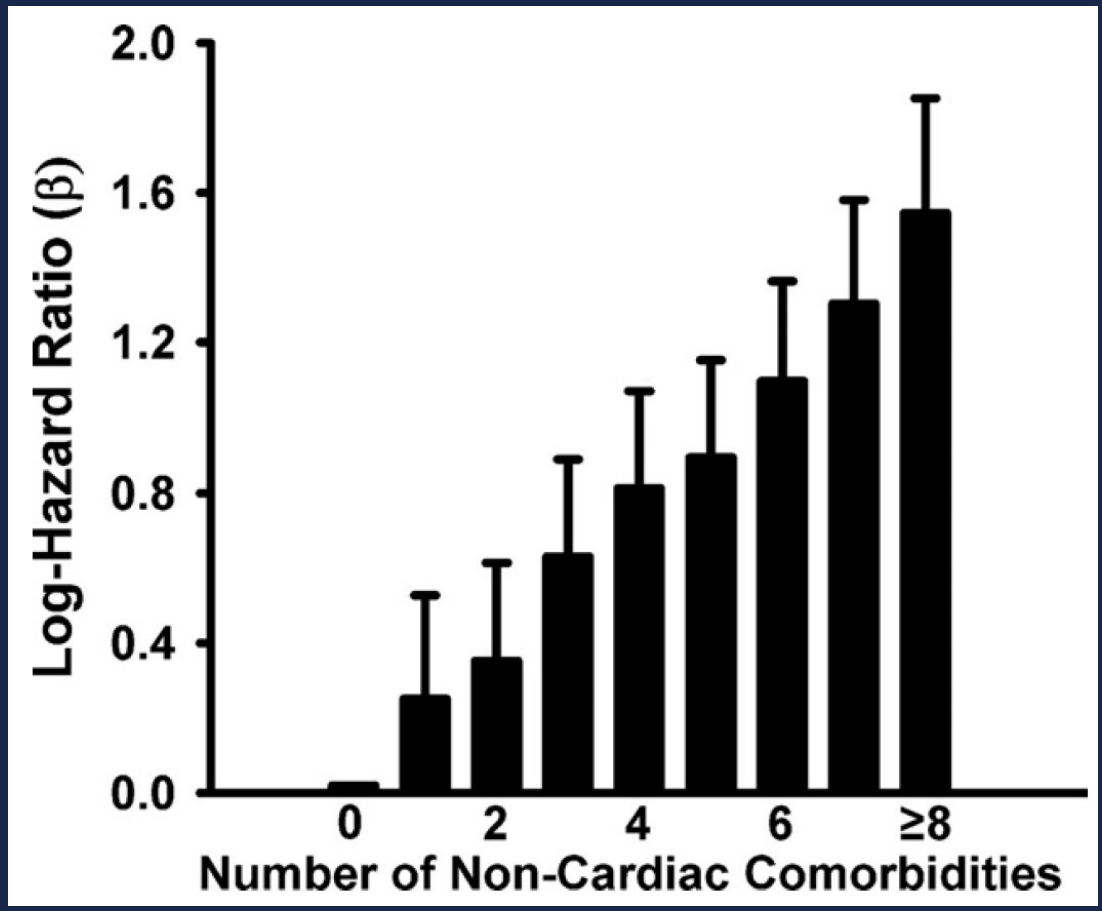
- Obesity
- Physical deconditioning

"Treatable"

- Metabolic syndrome
- HT
- AF Renal dysfunction
- OSA
- PAH
- COPD

Causes of Heart Failure Exacerbations in Patients with HFpEF

Ather S et al. JACC 2012;59:998-1005



PREVENTION

Diuretics for Treatment of HT & HFpEF

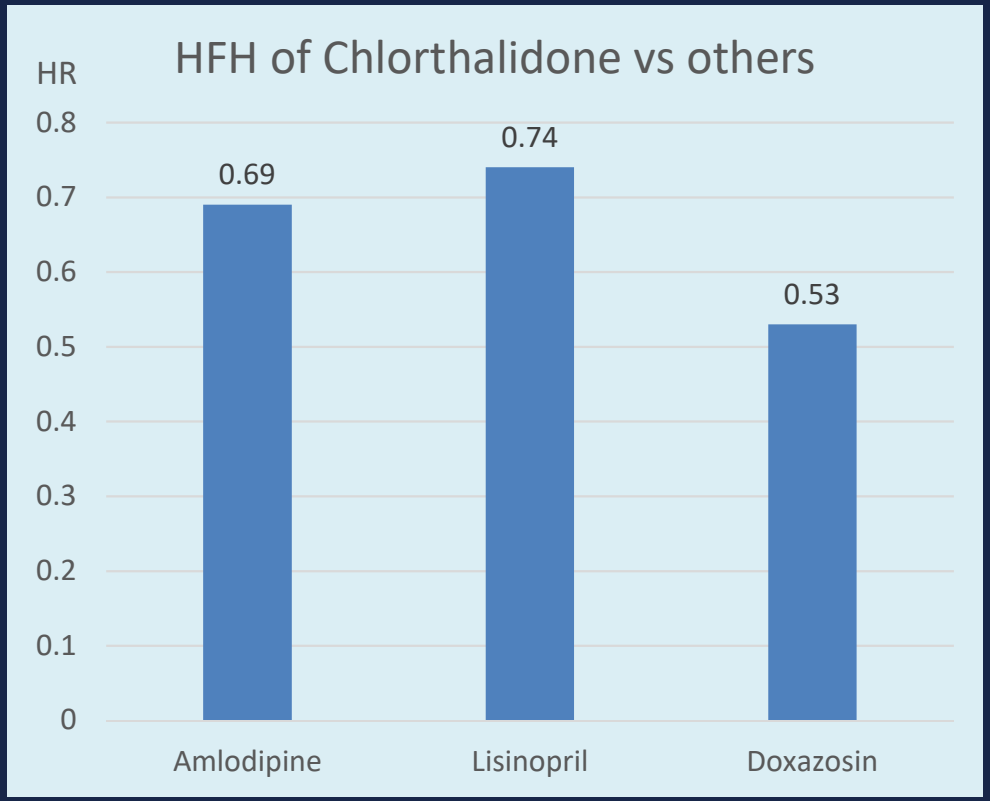
Davis BR et al. Circulation 2008;118:2259-2267

ALLHAT

910 HF with EF measured

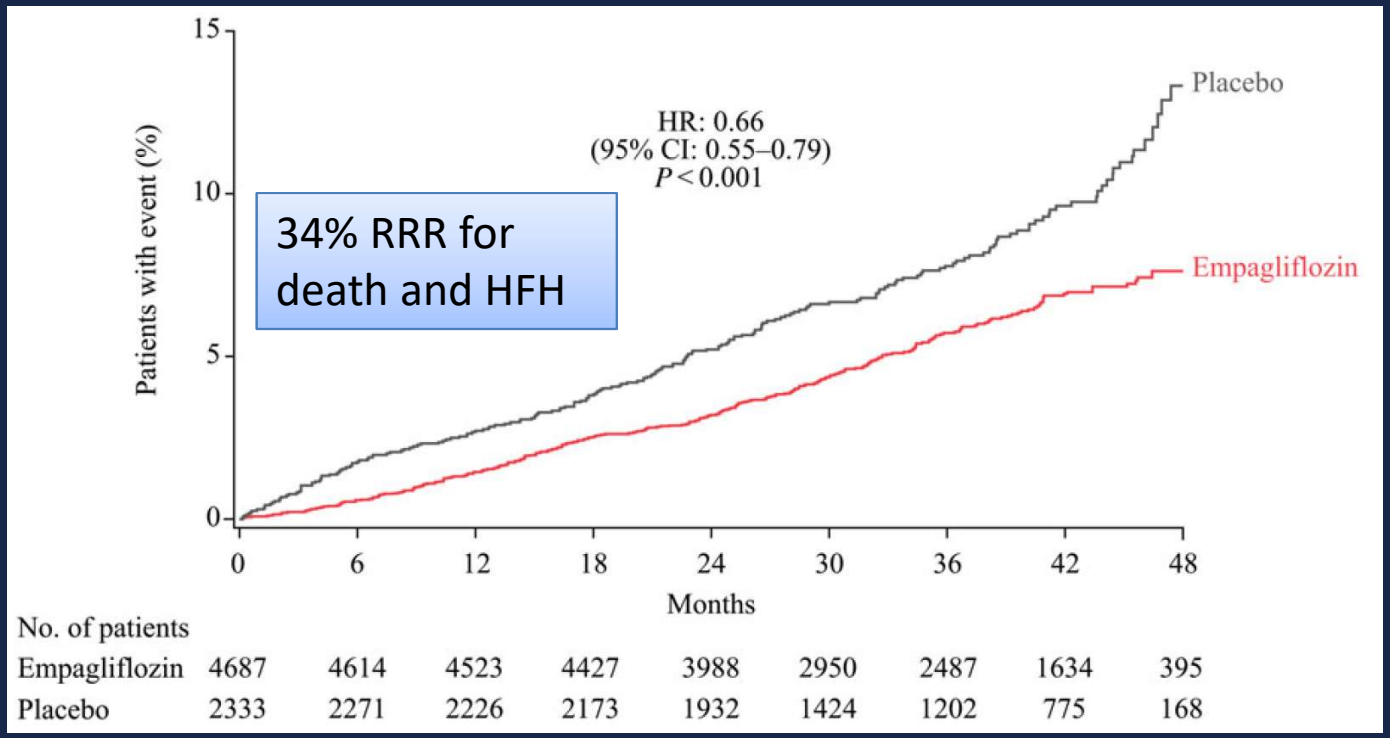
55.6% HFrEF

44.4% HFpEF



HF Event Reduced with SGLT-2 Inhibitors in high risk EMPA-REG OUTCOME Trial

Fitchett SD. EHJ 2016;37:1526-1534



- Baseline HF status uncertain, about half on diuretics
- Weight loss important factor for benefit

On-Going Trials of SGLT-2 in HFpEF

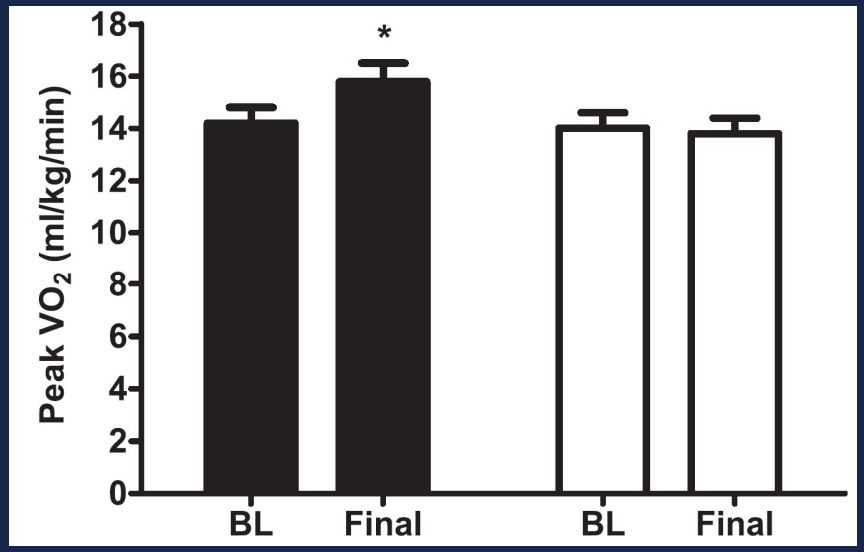
2019 Clinical Practice Update on HF, European HFA

SGLT2 inhibitor	Trial Name	Primary Outcome	N
Empagliflozin	EMPEROR-Preserved	Time to first CV death or hospitalization for HF	ca. 5500
Dapagliflozin	DELIVER	Time to first occurrence of CV death, hospitalization for HF, urgent HF visit	ca. 4700
Dapagliflozin	PRESERVED-HF	Change of NT-proBNP	320
Empagliflozin	EMPERIAL-Preserved	Change in 6-minute walk distance	300
Dapagliflozin	DETERMINE-preserved	Change in 6-minute walk distance	400
Empagliflozin	NCT03753087	Change in 6-minute walk distance	100

TREATMENT

Endurance Exercise Training & HFpEF

Kitzman DW et al. JACC 2013;62:584-92



Pts & Methods

63 HFpEF patients (70±7 yrs) were randomised to 16 wks ET vs attention control

Results & Conclusion:

Improved $_{pk}VO_2$ but not endothelial Function nor arterial stiffness

Fukuta et al 2019:

Meta-analysis of 8 RCTs of 436 pts: ⇧$VO_{2(max)}$, 6 MWD & QoL but not echo-Droppler parameters for systolic and diastolic function

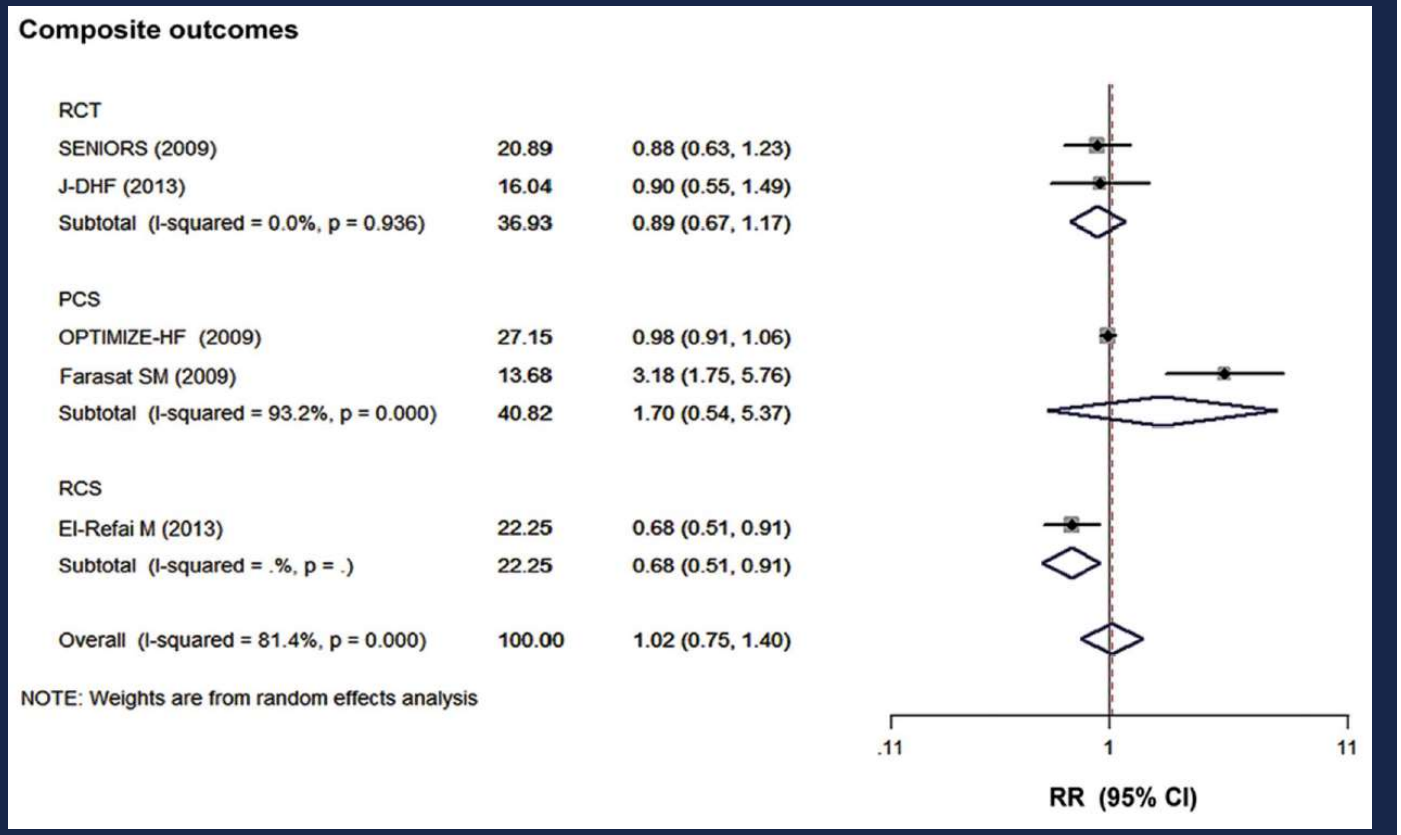
Betablockers in HFpEF: A meta-analysis

Liu F et al. PLoS ONE 2014;3:e90555

Meta-analysis of 12 clinical studies, 2 randomized (RCT), 10 observational studies (PCS or RCS) of 21,206 pts

Conclusion:

No definite benefit for composite nor individual outcomes. Results limited by insufficient RCT



Trials on HT & RAS Modulation

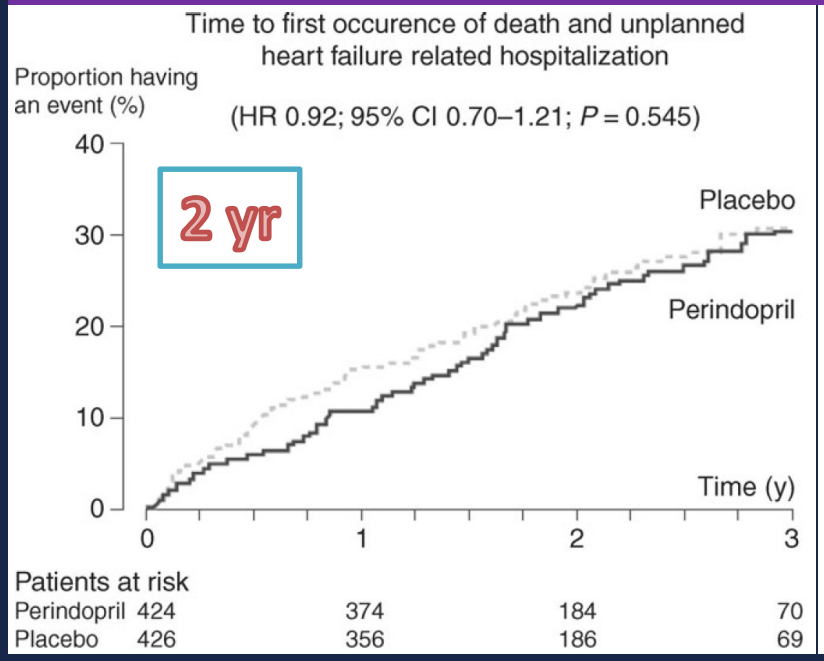
Trial (design) and reference	N	Intervention	Primary (key secondary) endpoints	Findings
CHARM (MC) (69)	3,023	candesartan	CV death or HF hsp	neutral (↓HF hsp)
PEP-CHF (MC) (70)	850	perindopril	death or HF hsp	neutral
I-PRESERVE (MC) (71)	4,128	irbesartan	death or CV hsp	neutral
Kitzman (SC) (72)	80	enalapril	peak VO2, 6MWD, VASC	neutral
ALDO-DHF (MC) (73)	422	spironolactone	E/e' and VO2 (6MWD, BNP, QOL)	↓E/e', BNP, 6MWD; ↔VO2, QOL
TOPCAT (MC) (74)	3,445	spironolactone	CV death or HF hsp or aborted sudden death	neutral: post hoc analyses by EF (75), region (76) or baseline BNP (77) suggest benefit in subgroups
Upadhya (SC) (78)	80	spironolactone	peak VO2 (6MWD, VASC)	neutral
RAAM-PEF (SC) (79)	44	eplerenone	6MWD (E/e', collagen biomarkers)	neutral (↓E/e' and collagen biomarkers)
Kosmala (SC) (80)	150	sprionolactone	VO2 and exc E/e'	positive
J-DHF (MC) (81)	245	carvedilol	CV death or HF hsp	neutral
ELAND (MC) (82)	116	nebivolol	6MWD (VO2, QOL, BNP)	neutral
Zile (MC) (83)	192	sitaxsentan	TM time (QOL)	positive (↔QOL)
PARAMOUNT (MC) (84)	301	valsartan/sacubitril	BNP (LA volume)	positive

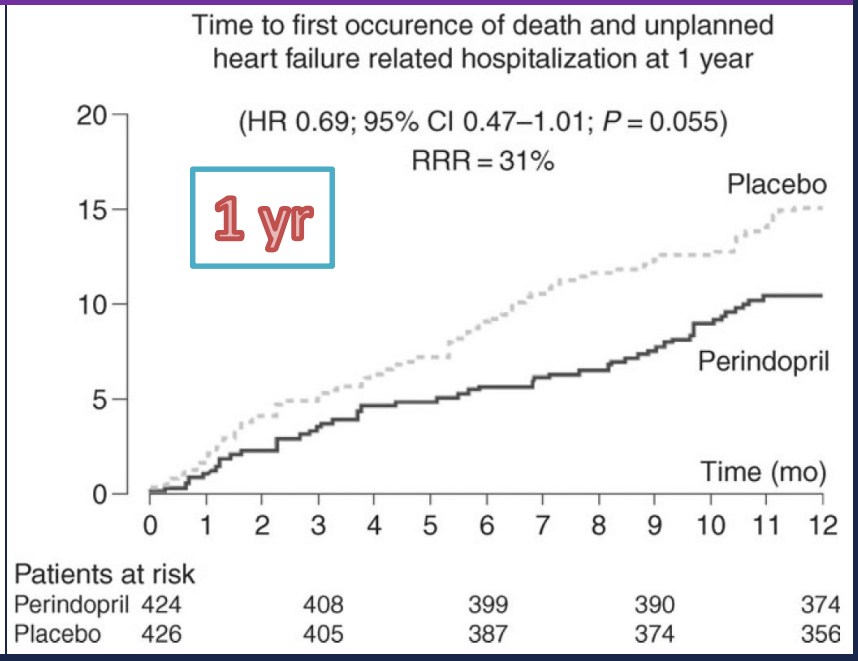
(Continued)

ACEI (Perindopril) in Elderly Pts with HFpEF (PEP-CHF)

Cleland JGF et al. EHJ 2006;27:2338-2345

1° Outcome of Death + HFH





Results & Conclusion: Of 850 pts randomised, primary outcome was not significantly better likely due to low events rate and poor compliance after 1 yr. Functional class and 6 MHW were improved

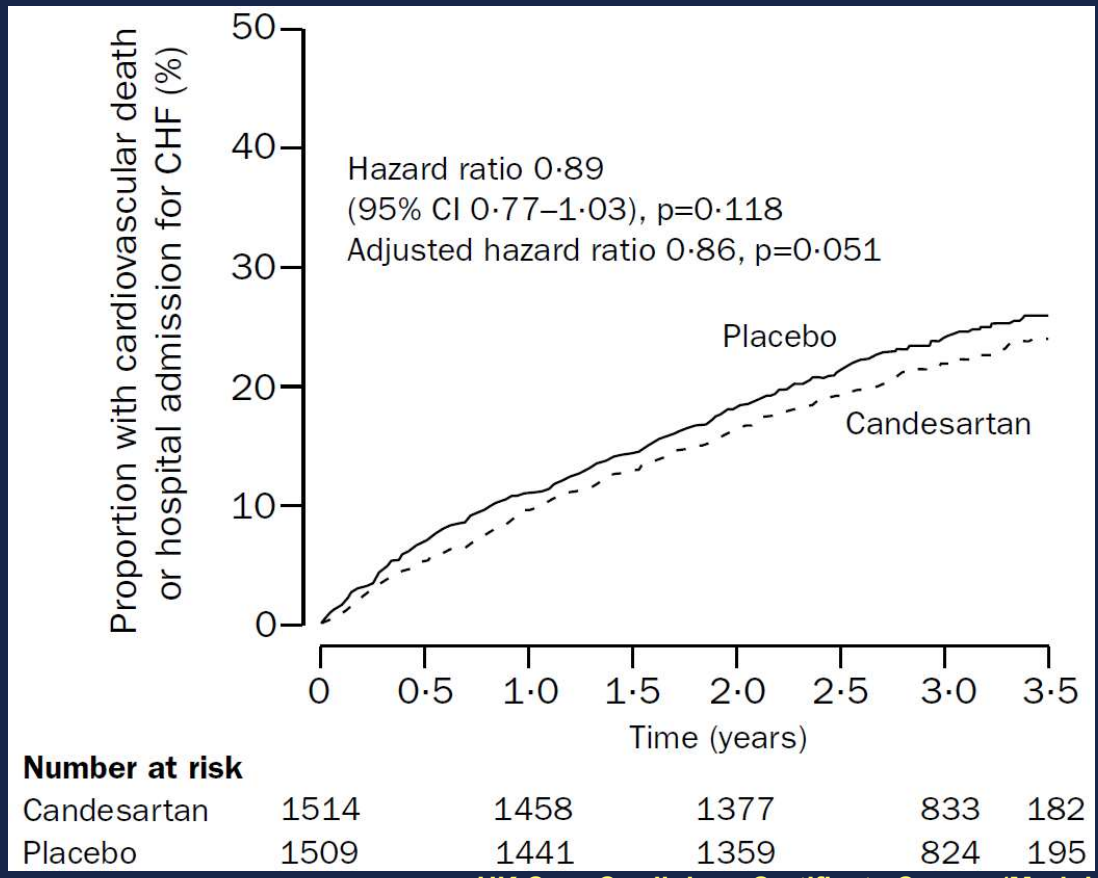
ARB (Candesartan) in HFpEF [CHARM-Preserve Trial]

Yusuf S. Lancet 2003;362:777-81

3,023 pts with LVEF > 40% + HF were randomised to candesartan or placebo

Conclusion:

There is no difference in primary endpoint but decrease in HFH



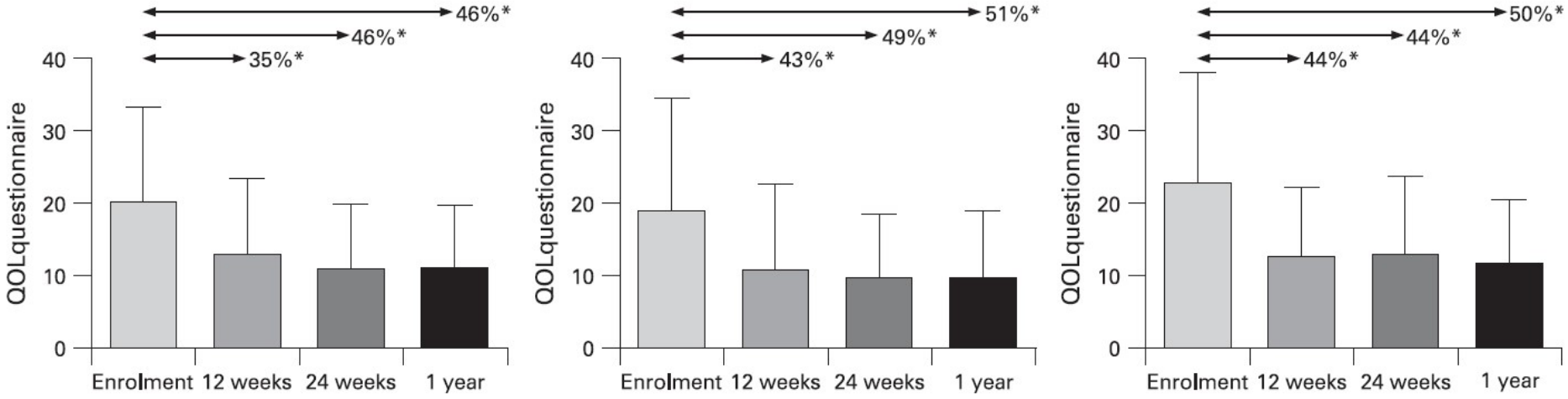
HK Diastolic HF Study

Yip GWK… Lau CP, Yu CM, Sanderson JE. Heart 2008;94:573-580 (1)

150 pts with HFpEF (LVEF > 45%) were randomised:

Mean age 74 yrs, Female ~60%

Diuretic	Irbesartan + Diuretic	Ramipril + Diuretic



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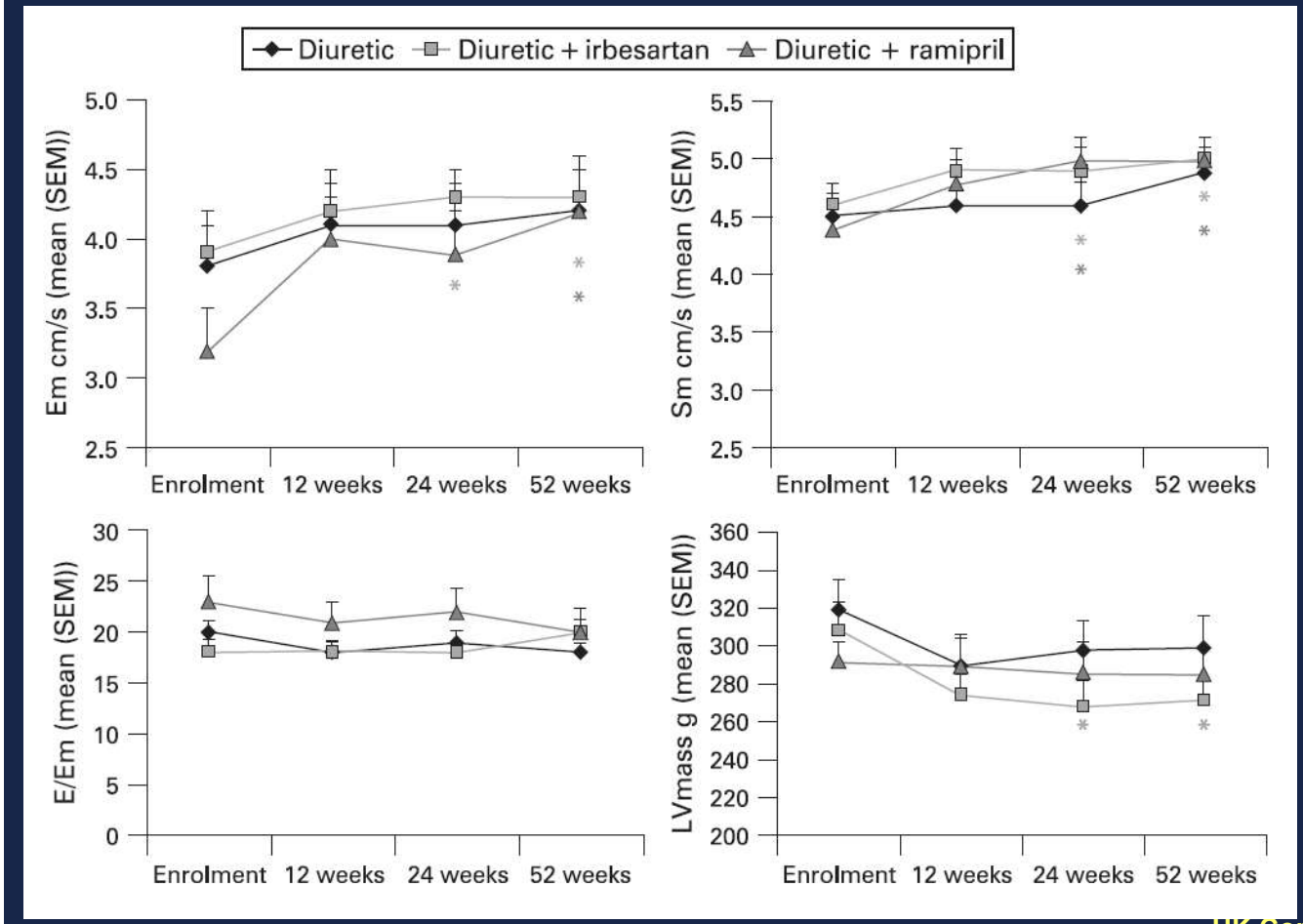
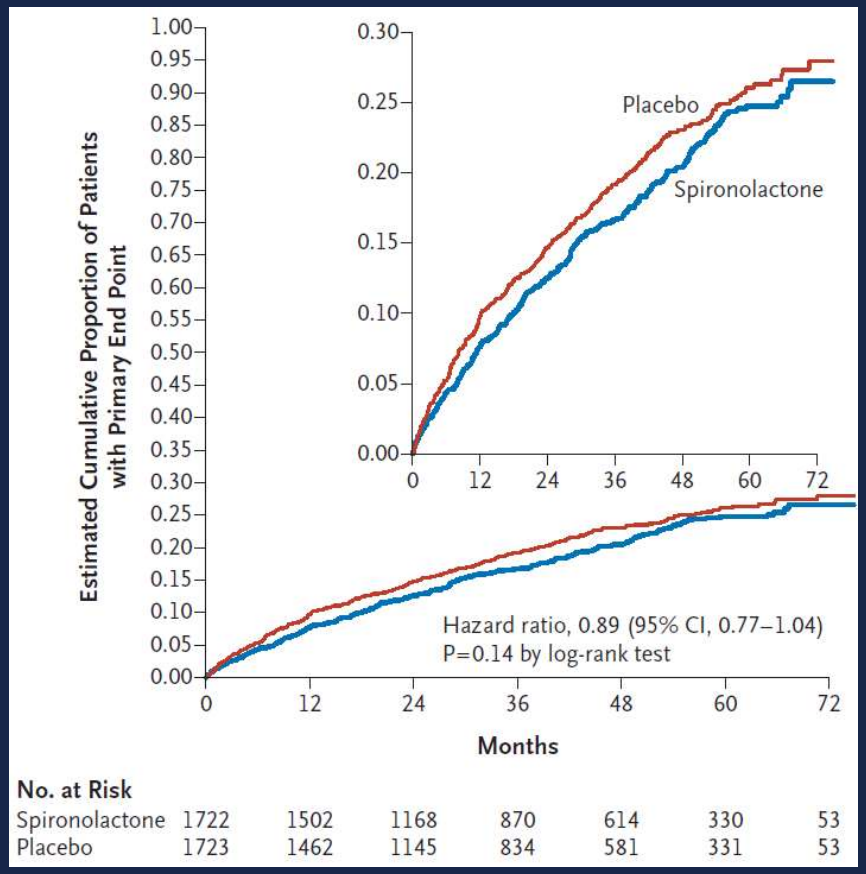


Diuretic improved symptoms. Addition of irbesartan or ramipril only marginally improved echo diastolic function and BNP level

Spironolactone for HFpEF (TOPCAT)

Pitt B et al. NEJM 2014;370:1383-1392 (1)



Pts & Methods

3,445 pts with HF and LVEF ≥ 45% received either spironolactone (ALD) vs placebo

Primary outcome

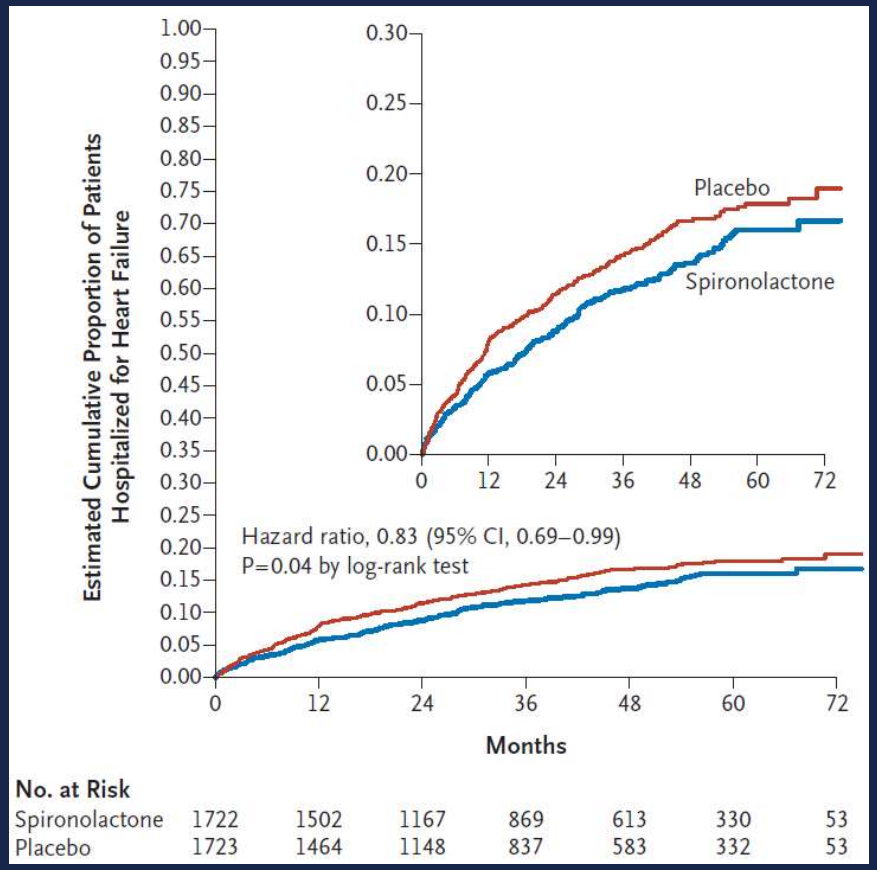
CVS death, SCA, HFH

Conclusion

ALD does not improve CVS outcome in HFpEF

Spironolactone for HFpEF (TOPCAT)

Pitt B et al. NEJM 2014;370:1383-1392 (2)



2° Endpoint

Reduce HFH

Side Effects

⇧ Creatinine

⇧K^+ (2X)

Limitations

1/3 had no DD

Americans had better response than Russians/Georgians

COR	LOE	Recommendations	Comment/ Rationale
I	B	Systolic and diastolic blood pressure should be controlled in patients with HF*p*EF in accordance with published clinical practice guidelines to prevent morbidity	2013 recommendation remains current.
I	C	Diuretics should be used for relief of symptoms due to volume overload in patients with HF*p*EF.	2013 recommendation remains current.

COR	LOE	Recommendations	Comment/ Rationale
IIa	C	Coronary revascularization is reasonable in patients with CAD in whom symptoms (angina) or demonstrable myocardial ischemia is judged to be having an adverse effect on symptomatic HF*p*EF despite GDMT.	2013 recommendation remains current.
IIa	C	Management of AF according to published clinical practice guidelines in patients with HF*p*EF is reasonable to improve symptomatic HF.	2013 recommendation remains current.
IIa	C	The use of beta-blocking agents, ACE inhibitors, and ARBs in patients with hypertension is reasonable to control blood pressure in patients with HF*p*EF.	2013 recommendation remains current.

COR	LOE	Recommendations	Comment/ Rationale
IIb	B-R	In appropriately selected patients with HF*p*EF (with EF ≥45%, elevated BNP levels or HF admission within 1 year, estimated glomerular filtration rate >30 mL/min, creatinine <2.5 mg/dL, potassium <5.0 mEq/L), aldosterone receptor antagonists might be considered to decrease hospitalizations.	NEW: Current recommendation reflects new RCT data.
IIb	B	The use of ARBs might be considered to decrease hospitalizations for patients with HF*p*EF.	2013 recommendation remains current.

NOVEL THERAPIES

COR	LOE	Recommendations	Comment/ Rationale
III: No Benefit	B-R	Routine use of nitrates or phosphodiesterase-5 inhibitors to increase activity or QoL in patients with HF*p*EF is ineffective.	NEW: Current recommendation reflects new data from RCTs.
III: No Benefit	C	Routine use of nutritional supplements is not recommended for patients with HF*p*EF.	2013 recommendation remains current.

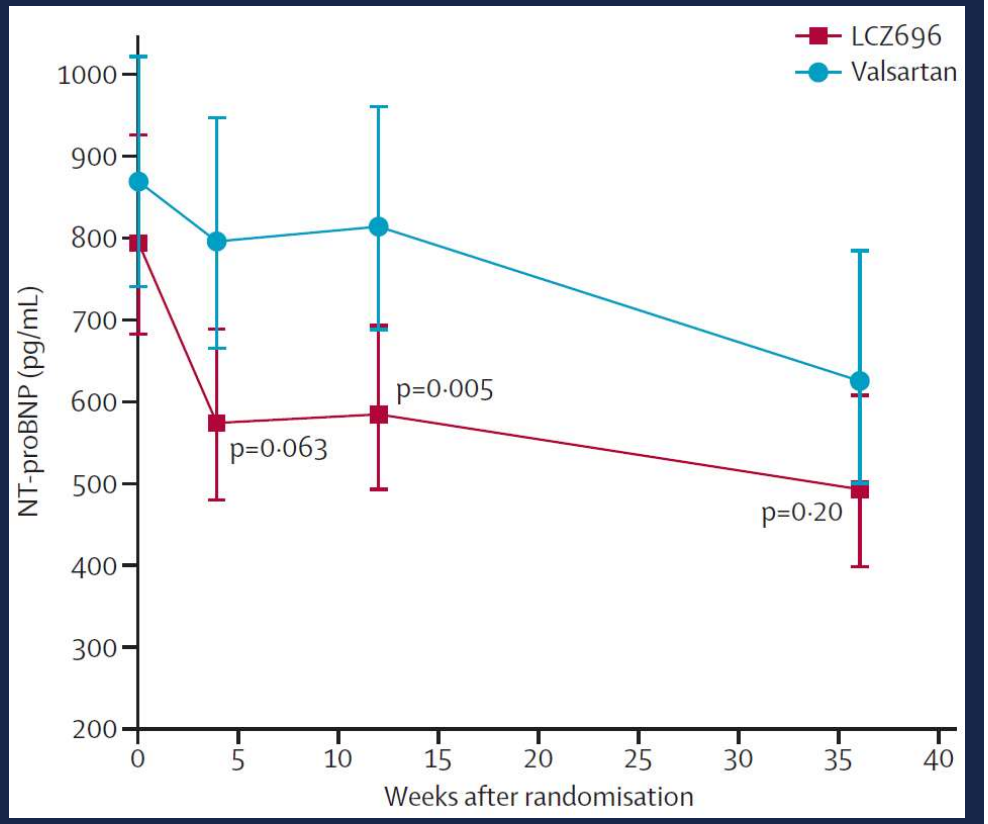
ARNI vs ARB in HFpEF. PARAMOUNT study

Solomon SD et al. Lancet 2012;386:1387-1395

149 pts received ARNI and 132 to ARB (Valsartan). ARNI improves LV wall stress and ∴ NT-ProBNP.

Conclusion: ARNI is superior to ARB than ARB in reducing NT-ProBNP in HFpEF in the short term. Clinical composite score and LA volume were also improved

PARAGON clinical Trial underway

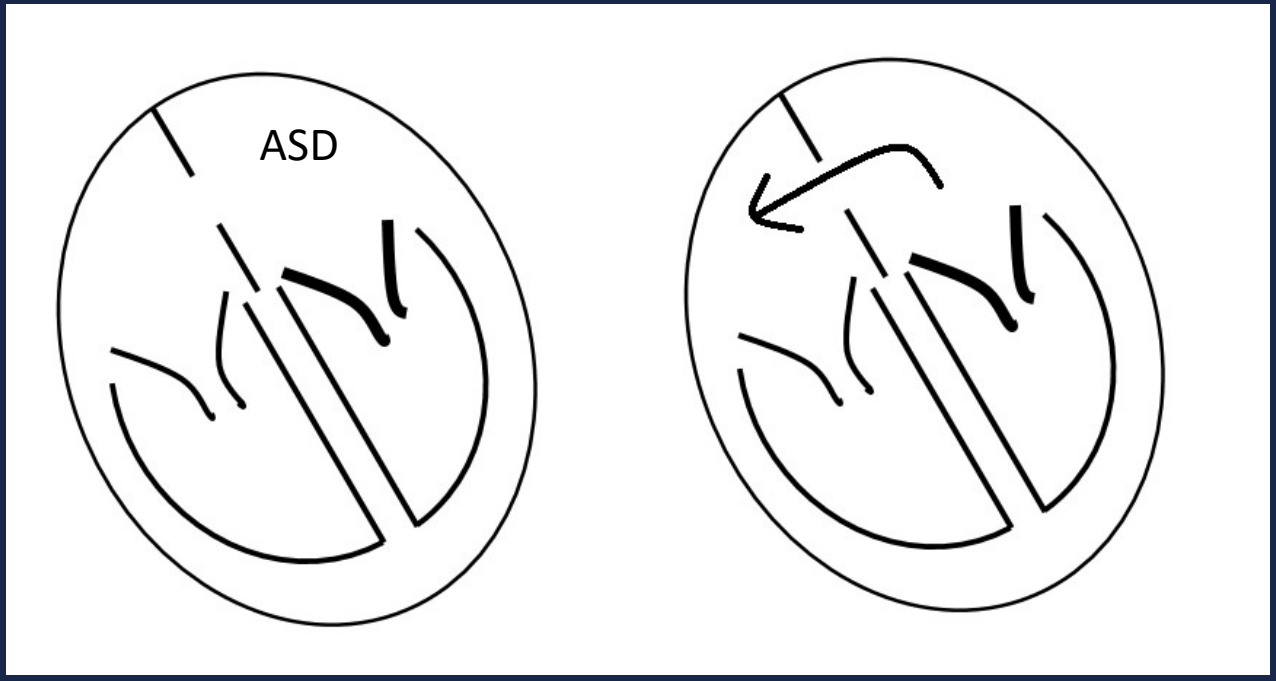


Transcatheter Intracardiac Shunt Device: REDUCE LAP-HF

Hasenfub G et al. Lancet 2016;378:1298-1304 (1)

Lutembacher Syndrome: MS + ASD

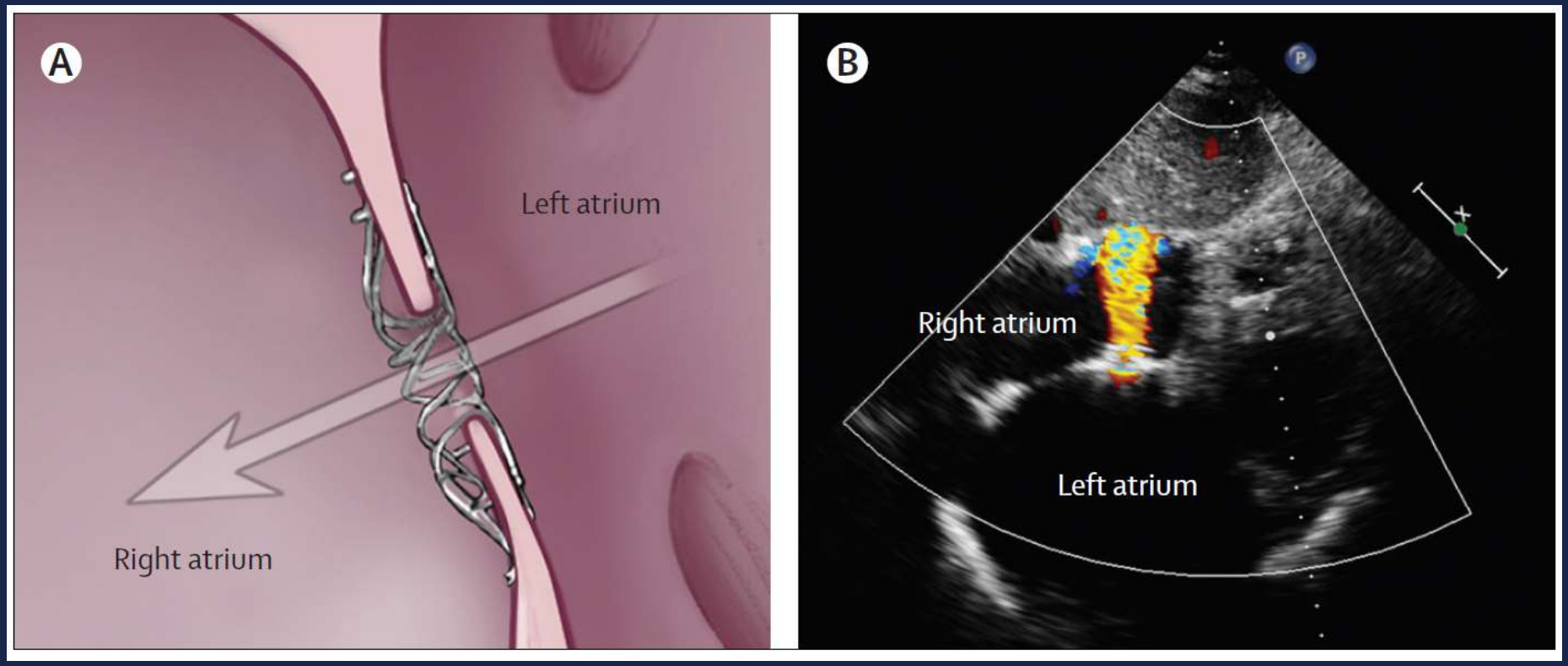
Patients better tolerate MS. Closure of ASD alone can lead to pulmonary oedema



Increase LAP is shunted to RA

Transcatheter Intracardiac Shunt Device: REDUCE LAP-HF

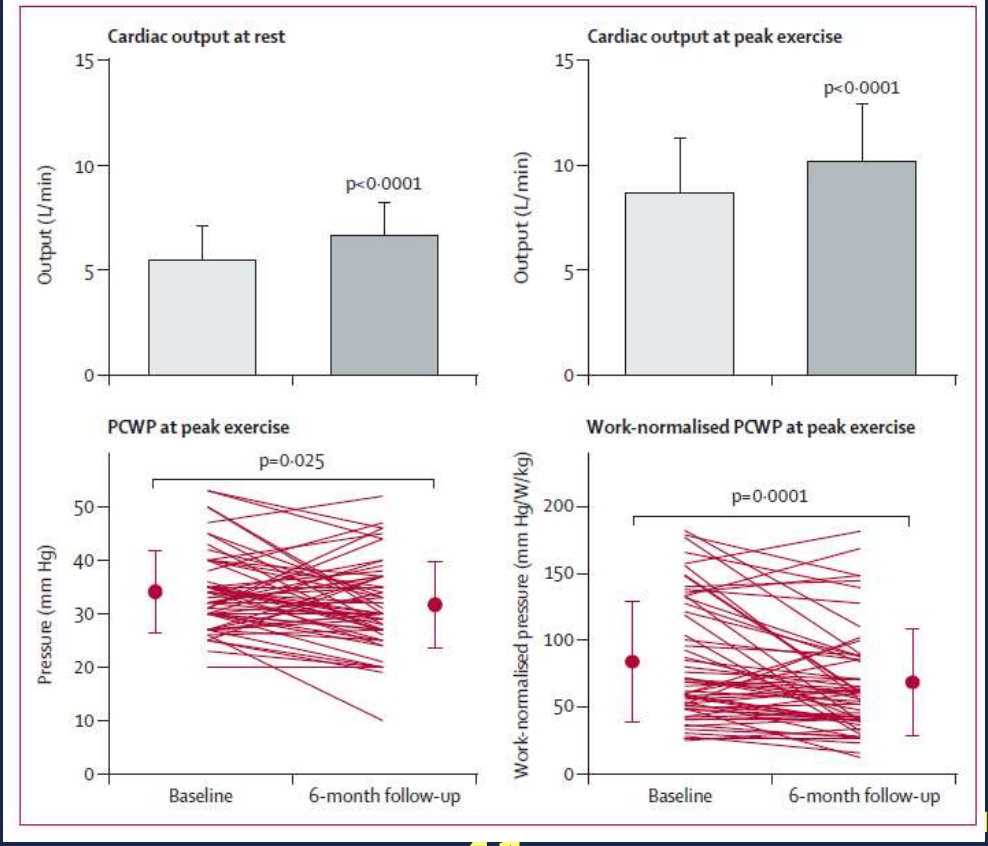
Hasenfub G et al. Lancet 2016;378:1298-1304 (2)



Transcatheter Intracardiac Shunt Device: REDUCE LAP-HF

Hasenfub G et al. Lancet 2016;378:1298-1304 (3)

64/68 eligible patients received the IASD (Corvia Medical, MA, WSA)



New Treatment Evidence for HFmrEF

2019 Clinical Practice Update on HF, European HFA

1. **Beta-blockers**

   Betameta-HF meta-analysis on 11 major HF trials & 575 pts. BB reduced all cause CVS death by 4.7% NNT 21 for 1.3 years. No change in HFH

2. **Candesartan**

   1,322 pts in a meta subgroup analysis reduced CV death & HFH

3. **Spironolactone**

   TOP-CAT post-hoc analysis: ⇩CVD + HFH

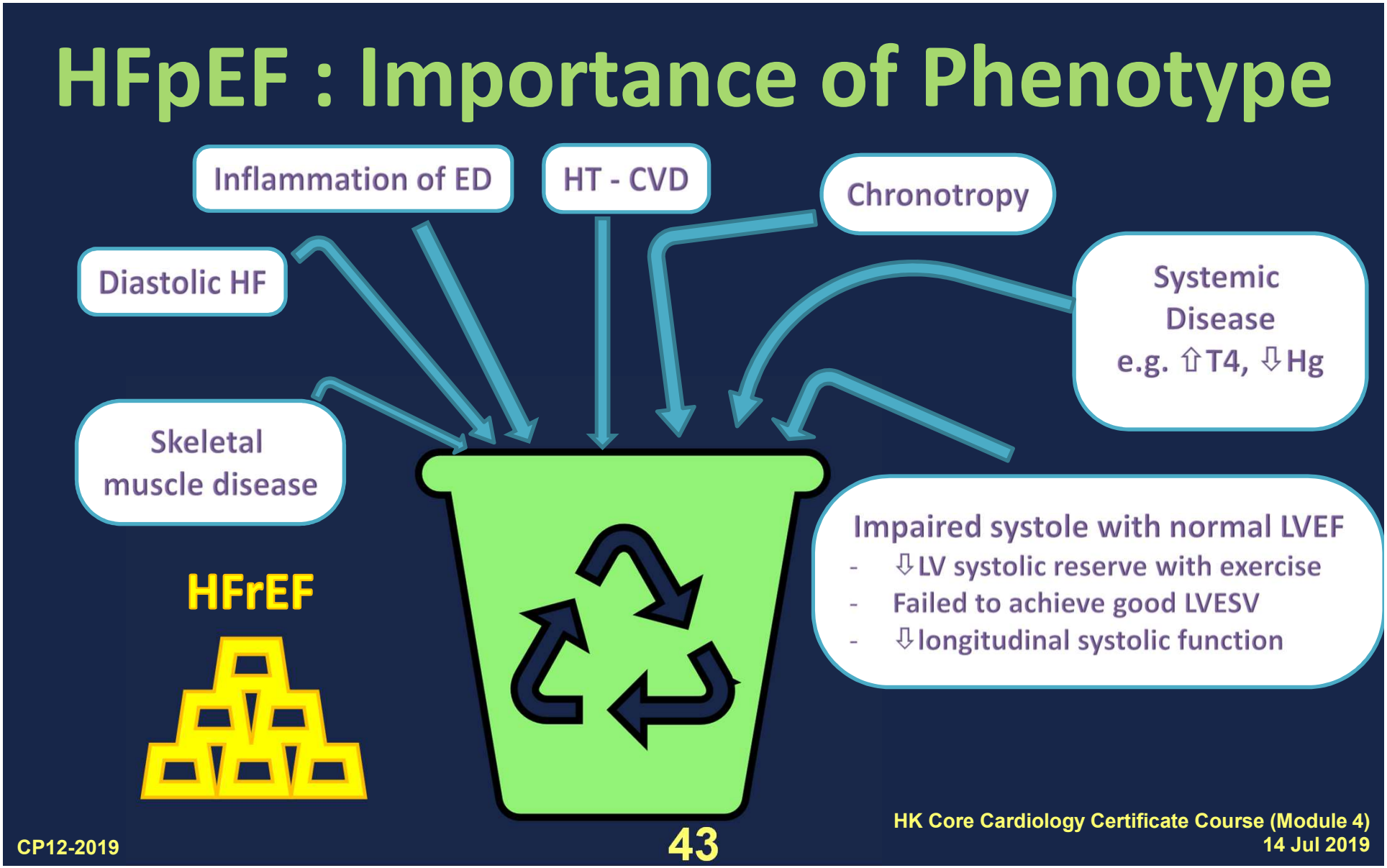
4. **Negative trials**

   ivi iron

   Rivaroxaban (all HF)

Conclusion:
HFmrEF treated as HFrEF

HFpEF : Importance of Phenotype



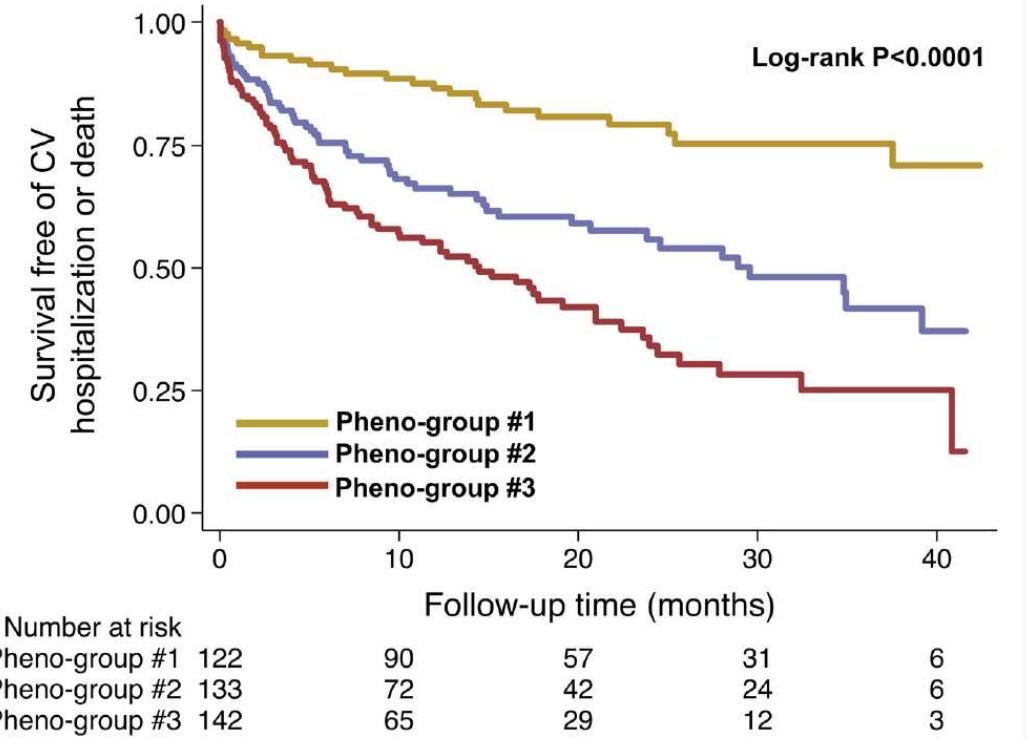
Phenomapping for HFpEF

Clinical characteristic	Group 1 (N=128)	Group 2 (N=120)	Group 3 (N=149)	P-value
Age, years	60.7±13.6	65.7±11.3	67.3±13.1	<0.001
Female, n(%)	86 (67)	81 (68)	82 (55)	0.049
Race, n(%)				0.32
White	72(56)			
Black	42(33)	54(45)	56(38)	
Other	14(11)		16(11)	
NYHA functional class, n(%)				
I			13(9)	
II	61(48)		56(38)	
III	38(30)	64(53)	78(52)	
IV	3(2)	3(4)	2(1)	
Comorbidities, n(%)				
Coronary artery disease	54 (42)	58 (48)	75 (50)	0.38
Hypertension	84 (66)	108 (90)	112 (75)	<0.001
Hyperlipidemia	65 (51)	75 (62)	73 (49)	0.06
Diabetes mellitus	12 (9)	63 (52)	50 (34)	<0.001
Obesity	65 (51)	84 (70)	55 (37)	<0.001
Chronic kidney disease	8 (6)	41 (34)	79 (53)	<0.001
Atrial fibrillation	17 (13)	26 (22)	64 (43)	<0.001
Chronic obstructive pulmonary disease	43 (34)	46 (38)	56 (38)	0.70
Obstructive sleep apnea	35 (27)	60 (50)	46 (31)	<0.001
Vital signs and laboratory data				
Heart rate, bpm	77.2±14.5	74.7±14.9	71.6±12.6	0.004
Systolic blood pressure, mmHg	122.4±16.6	129.2±19.0	123.0±22.7	0.011
Diastolic blood pressure, mmHg	73.3±10.2	70.1±10.2	67.3±13.6	<0.001
Pulse pressure, mmHg	49.1±12.4	59.2±16.9	55.7±19.6	<0.001
Body mass index, kg/m^2	31.2±7.3	37.0±10.7	28.9±7.4	<0.001
Serum sodium, mEq/L	139.0±3.0	138.4±2.6	137.9±2.9	0.01
Blood urea nitrogen, mg/dl	13.7±4.5	24.4±11.8	33.6±19.9	<0.001
Serum creatinine, mg/dl	0.9±0.2	1.3±0.4	2.3±2.2	<0.001
Estimated GFR, ml/min/1.73m^2	79.5±21.2	53.8±17.6	43.9±27.3	<0.001
Fasting glucose, mg/dl	98.4±15.6	153.2±85.2	111.5±29.2	<0.001
Hemoglobin, g/dl	12.5±1.7	11.8±1.8	11.4±1.9	<0.001
B-type natriuretic peptide, pg/ml	72(26–161)	188(83–300)	607(329–1138)	<0.001
Medications, n(%)				
ACE-inhibitor or ARB	61 (48)	84 (70)	72 (48)	<0.001
β-blocker	67 (52)	89 (74)	112 (75)	<0.001
Calcium channel blocker	31 (24)	45 (38)	44 (30)	0.073
Nitrate	5 (4)	19 (16)	33 (22)	<0.001

Younger Low BNP

Obese DM OSA

Obese DM OSA Oldest CDK High BNP



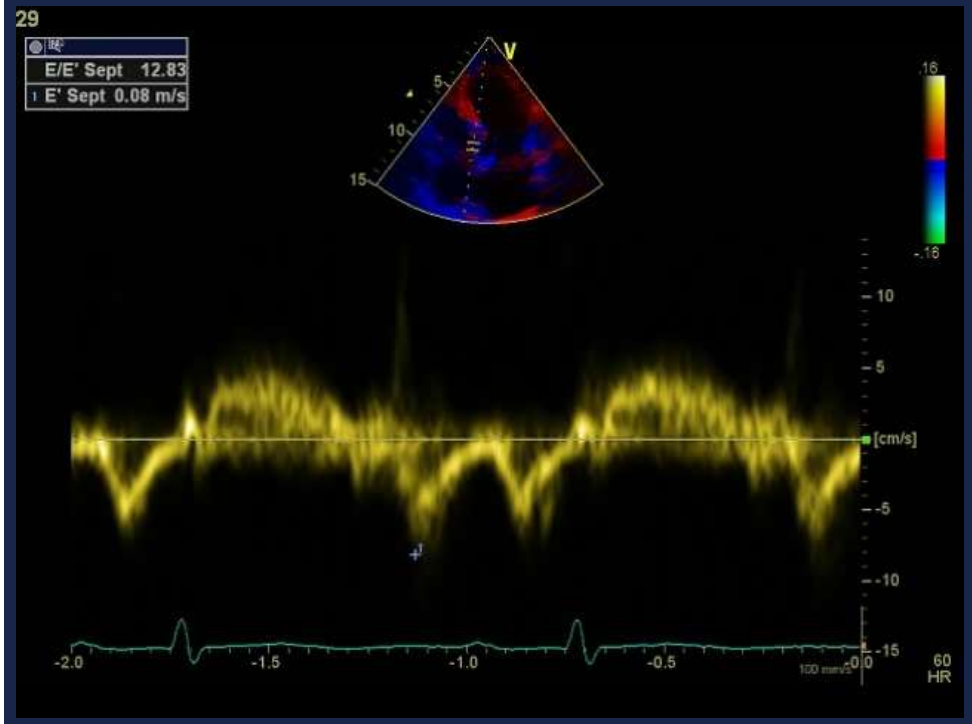
Shah SJ et al. Circulation 2015;131:269-79

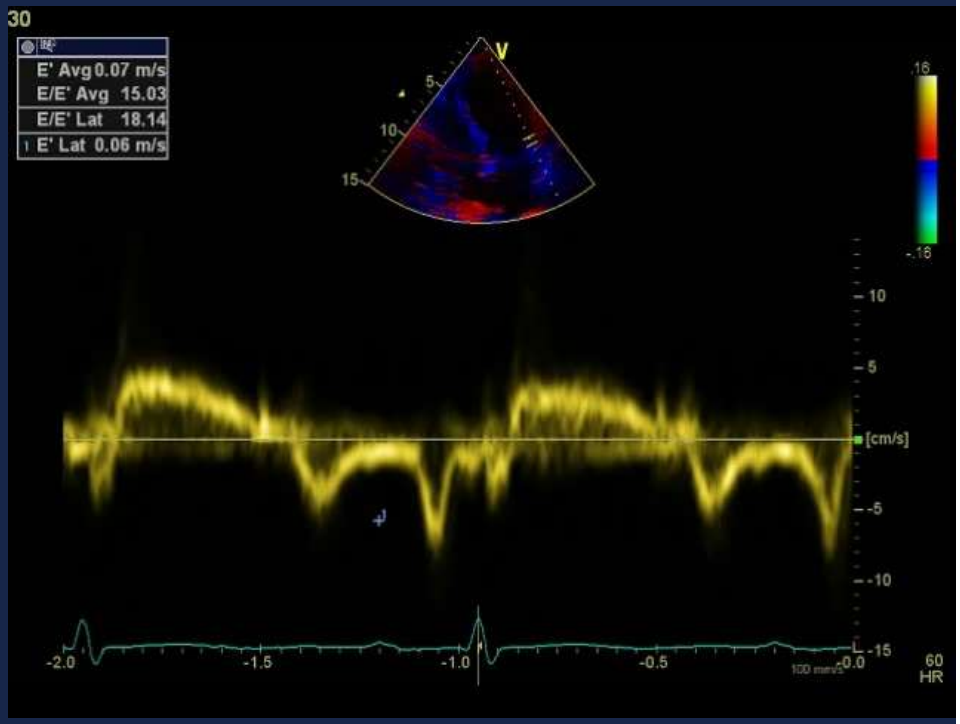
HFpEF Predisposition Phenotypes	HFpEF Clinical Presentation Phenotypes					
		Lung Congestion	+Chronotropic Incompetence	+Pulmonary Hypertension (CpcPH)	+Skeletal muscle weakness	+Atrial Fibrillation
	Overweight/obesity/ metabolic syndrome/ type 2 DM	• **Diuretics (loop diuretic in DM)** • **Caloric restriction** • Statins • Inorganic nitrite/nitrate • Sacubitril • Spironolactone	+Rate adaptive atrial pacing	+Pulmonary vasodilators (e.g. PDE5I)	**+Exercise training program**	+Cardioversion + Rate Control **+Anticoagulation**
	+Arterial hypertension	+ACEI/ARB	+ACEI/ARB +Rate adaptive atrial pacing	+ACEI/ARB +Pulmonary vasodilators (e.g. PDE5I)	+ACEI/ARB **+Exercise training program**	+ACEI/ARB +Cardioversion + Rate Control **+Anticoagulation**
	+Renal dysfunction	+Ultrafiltration if needed	+Ultrafiltration if needed +Rate adaptive atrial pacing	+Ultrafiltration if needed +Pulmonary vasodilators (e.g. PDE5I)	+Ultrafiltration if needed **+Exercise training program**	+Ultrafiltration if needed +Cardioversion + Rate Control **+Anticoagulation**
	+CAD	+ACEI +Revascularization	+ACEI +Revascularization +Rate adaptive atrial pacing	+ACEI +Revascularization +Pulmonary vasodilators (e.g. PDE5I)	+ACEI +Revascularization **+Exercise training program**	+ACEI +Revascularization +Cardioversion + Rate Control **+Anticoagulation**

Shah SJ et al. Circulation 2016;134:73-90

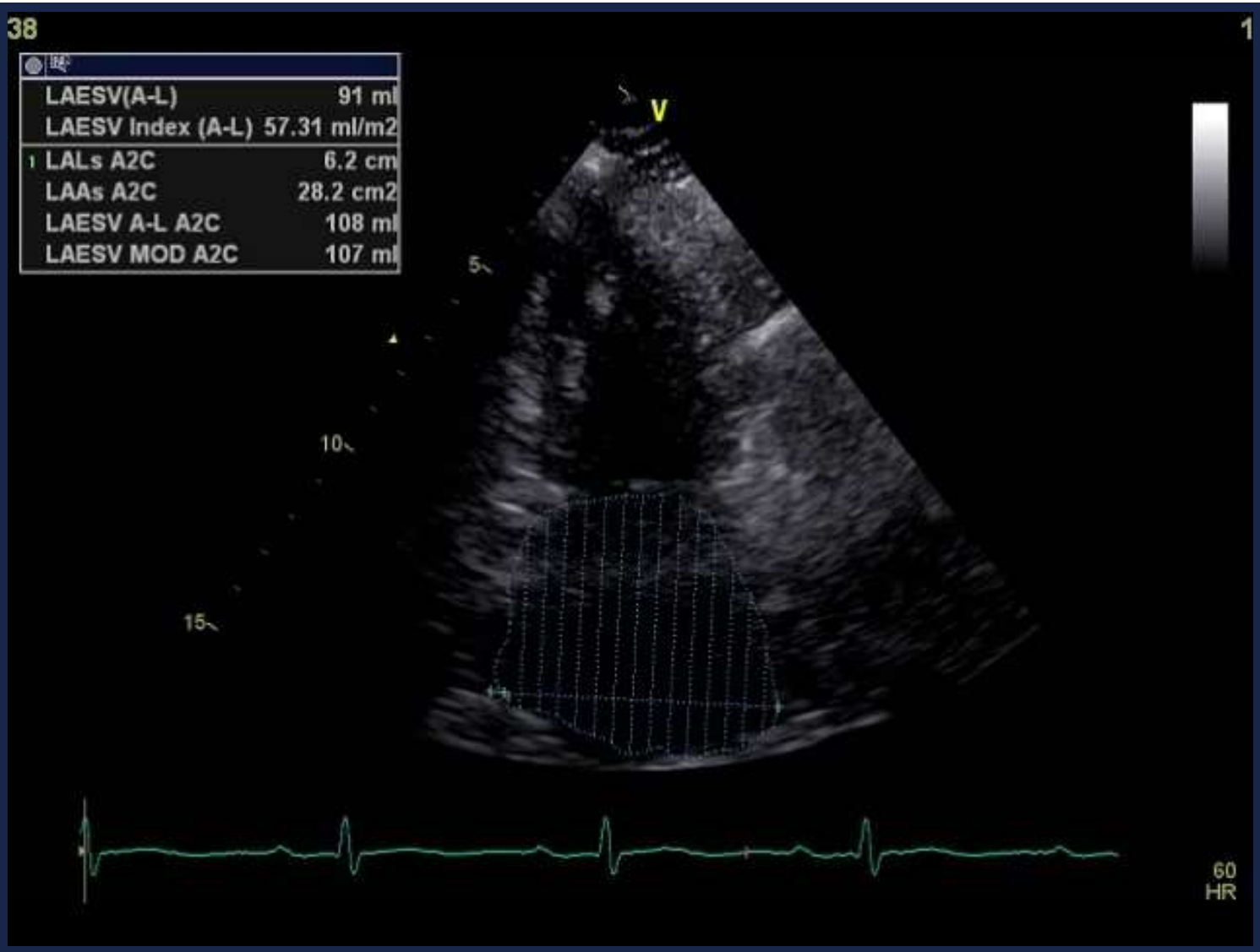
Conclusion

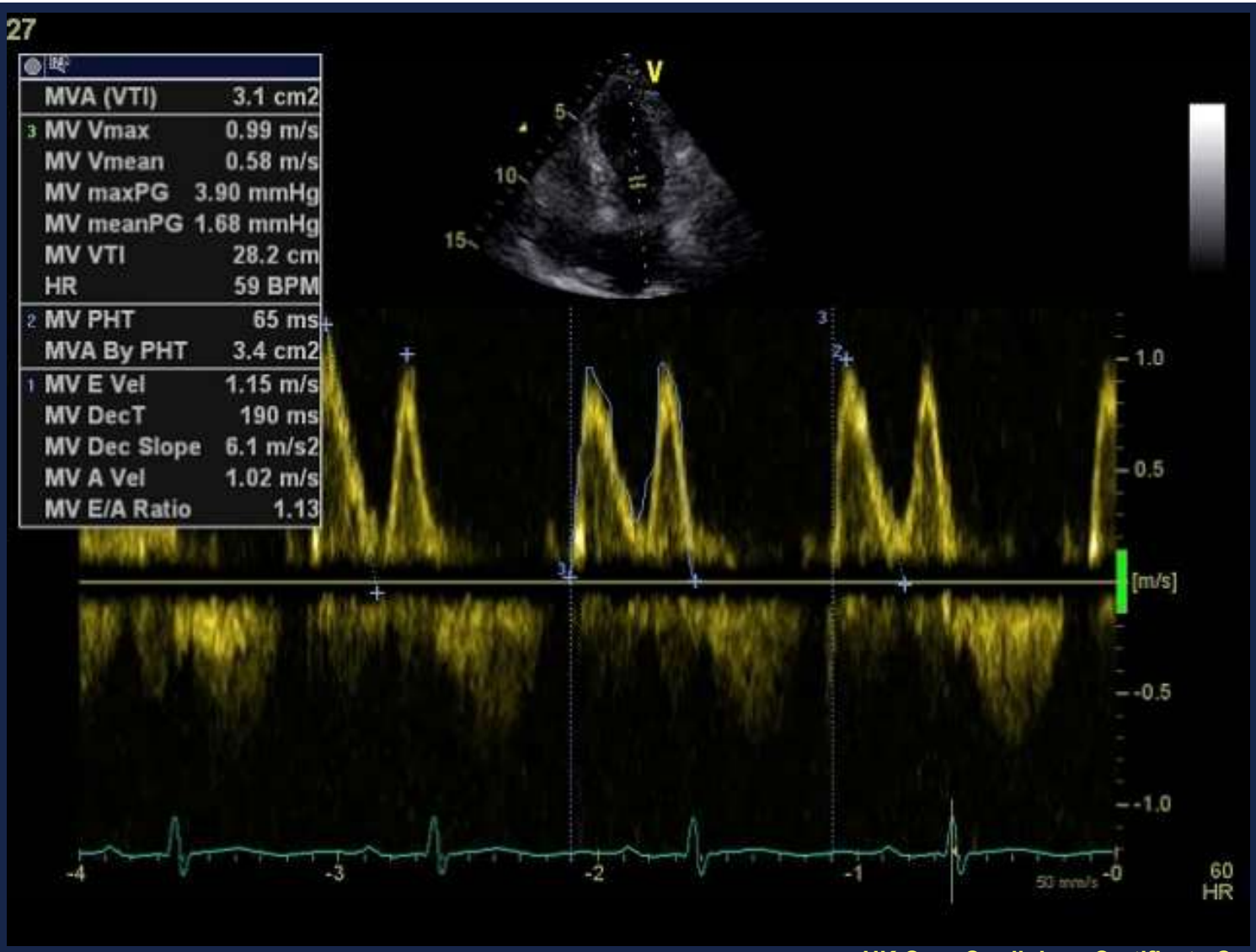
- Confirm diagnosis and exclude ddx of HFpEF
- Management depends on aetiologies and ppt factors
- Fluid volume management important
- Treatment of HT is the key
- Spironolactone (& candesartan) can reduce HFH
- New therapies evolving

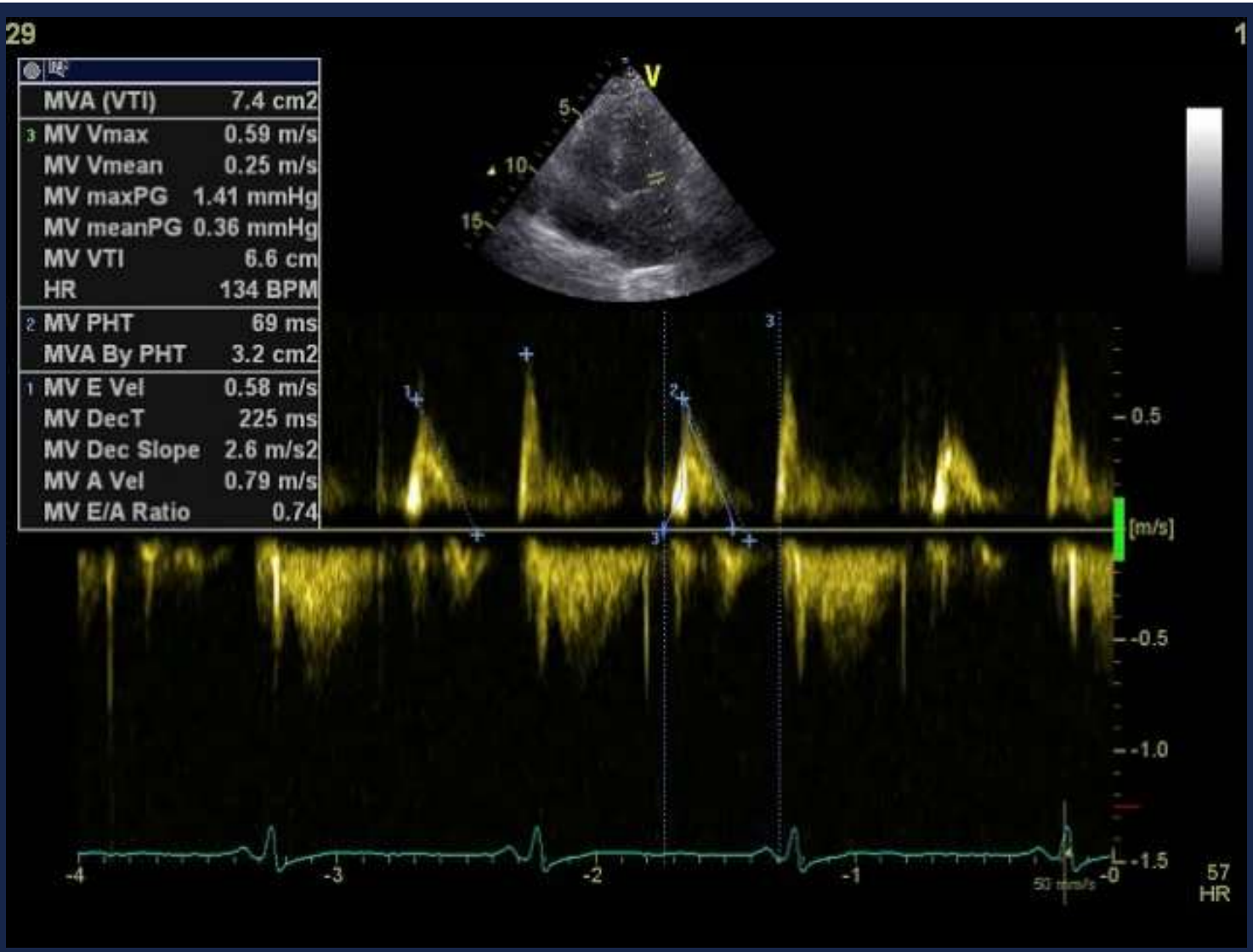

29
E/E' Sept 12.83
E' Sept 0.08 m/s
V
5
10
15
.16
-.16
10
5
[cm/s]
-5
-10
-15
-2.0
-1.5
-1.0
-0.5
0.0
100 mm/s
60
HR

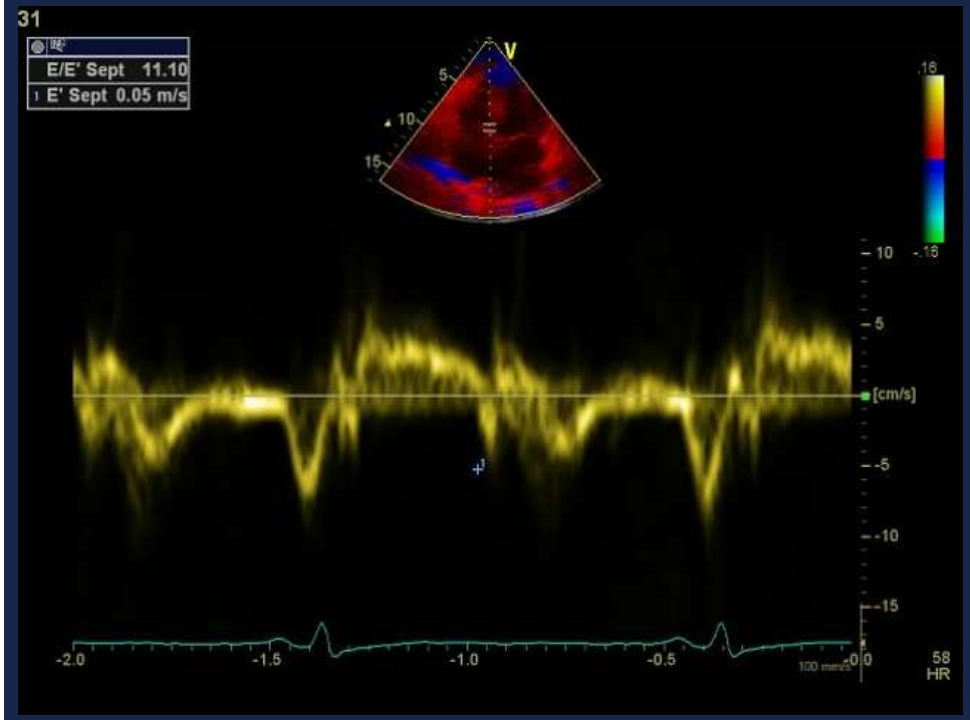

30
E' Avg 0.07 m/s
E/E' Avg 15.03
E/E' Lat 18.14
E' Lat 0.06 m/s
V
5
10
15
.16
-.16
10
5
[cm/s]
-5
-10
-15
-2.0
-1.5
-1.0
-0.5
0.0
100 mm/s
60
HR

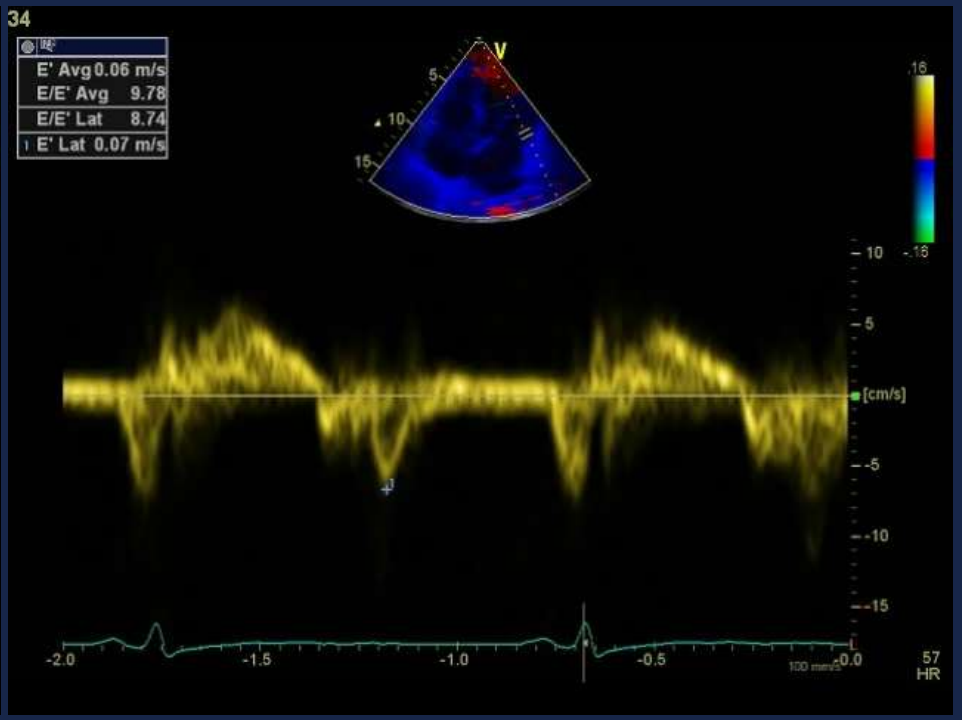
W1

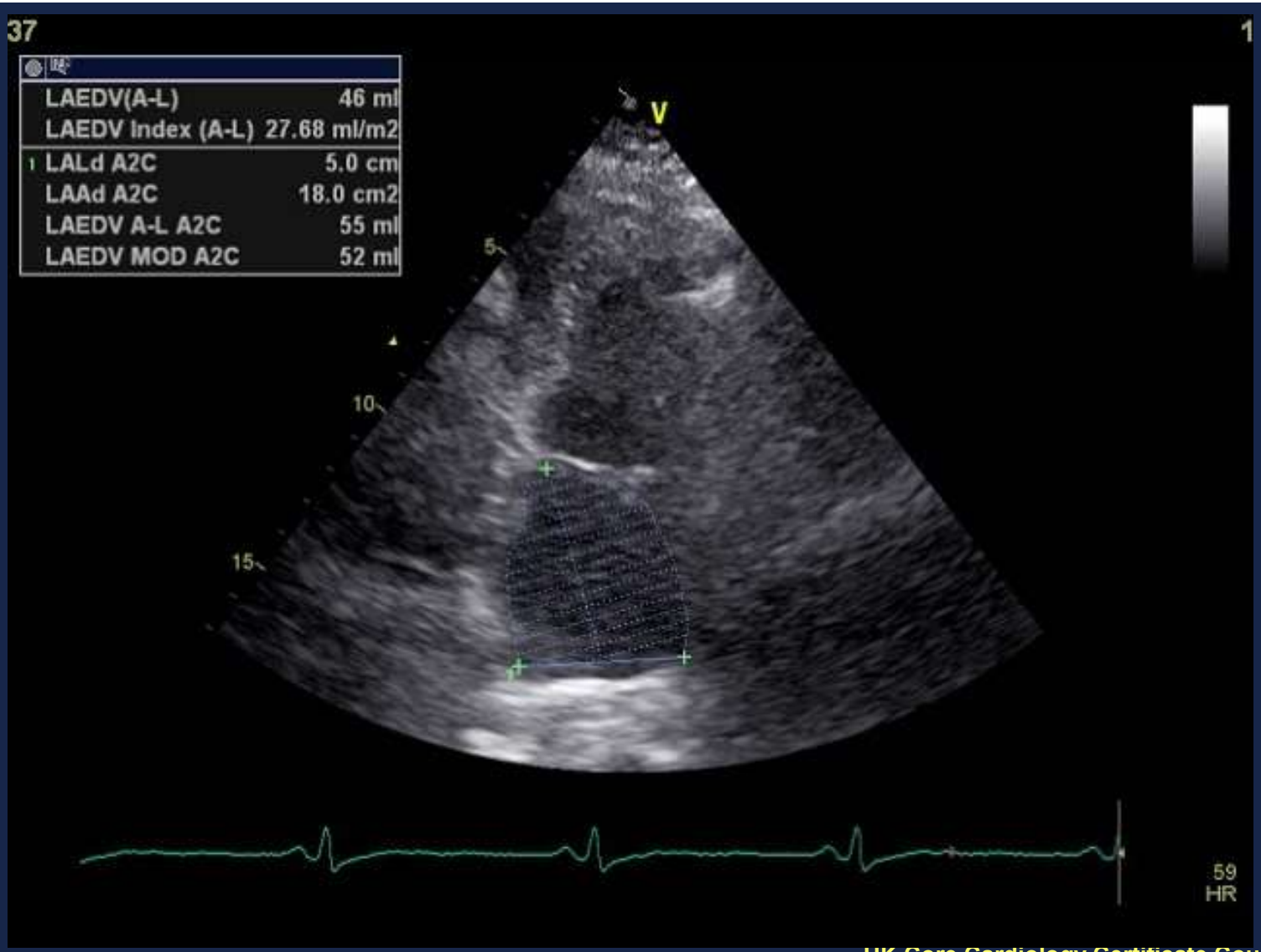

38
1
LAESV(A-L) 91 ml
LAESV Index (A-L) 57.31 ml/m2
LALs A2C 6.2 cm
LAAs A2C 28.2 cm2
LAESV A-L A2C 108 ml
LAESV MOD A2C 107 ml
V
5
10
15
60
HR


27
MVA (VTI) 3.1 cm2
3 MV Vmax 0.99 m/s
MV Vmean 0.58 m/s
MV maxPG 3.90 mmHg
MV meanPG 1.68 mmHg
MV VTI 28.2 cm
HR 59 BPM
2 MV PHT 65 ms
MVA By PHT 3.4 cm2
1 MV E Vel 1.15 m/s
MV DecT 190 ms
MV Dec Slope 6.1 m/s2
MV A Vel 1.02 m/s
MV E/A Ratio 1.13
V
5
10
15
1.0
0.5
[m/s]
-0.5
-1.0
-4
-3
-2
-1
-0
50 mm/s
60
HR


29
1
MVA (VTI) 7.4 cm2
3 MV Vmax 0.59 m/s
MV Vmean 0.25 m/s
MV maxPG 1.41 mmHg
MV meanPG 0.36 mmHg
MV VTI 6.6 cm
HR 134 BPM
2 MV PHT 69 ms
MVA By PHT 3.2 cm2
1 MV E Vel 0.58 m/s
MV DecT 225 ms
MV Dec Slope 2.6 m/s2
MV A Vel 0.79 m/s
MV E/A Ratio 0.74
V
5
10
15
0.5
[m/s]
-0.5
-1.0
-1.5
-4
-3
-2
-1
-0
57
HR


31
E/E' Sept 11.10
E' Sept 0.05 m/s
[cm/s]
58
HR


34
E' Avg 0.06 m/s
E/E' Avg 9.78
E/E' Lat 8.74
E' Lat 0.07 m/s
[cm/s]
57
HR


37
1
LAEDV(A-L) 46 ml
LAEDV Index (A-L) 27.68 ml/m2
LALd A2C 5.0 cm
LAAd A2C 18.0 cm2
LAEDV A-L A2C 55 ml
LAEDV MOD A2C 52 ml
V
5
10
15
59
HR