



Dealing Heart Failure with Low Blood Pressure

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Introduction

- Most patients admitted for heart failure have normal / high blood pressure, but **15 – 25% have low systolic BP** with / without signs and/or symptoms of hypoperfusion
- Patients with HF and Low BP have much **higher in-hospital and post-discharge mortality**. Hypotension can be a **sign of advanced HF** and is associated with worse prognosis.
- It is challenging to uptitrate GDMT, and it can also be a side effect of the HF treatment

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Mr. J. 64 years old

Case Presentation

Chief Complaint Shortness of breath

Description

- Admitted to RSUPHAM with worsening complaint of the previous 2 days. DOE, Orthopnea and PND were also found. Pretibial oedema was found on both lower extremities.
- History of Shortness of breath was found and hospitalized 5 months ago at different hospital, for about 2 weeks.
- Cough(+) Productive, history of Fever in the last 3 days, well-respond with antipyretic.
- ACS was found in 2020, and underwent Coronary Angiography with PCI and staging PCI another stenosis vessel 4 months afterwards.

Previous Diseases: CHF, CAD Post PCI (2020), DM type 2, Hypertension

Previous Used Drugs:

Carvedilol 12,5mg bid,
Spironolactone 100mg od
Ramipril 2,5mg bid
Digoxin 0,25mg od
Ivabradine 5mg bid

Furosemide 40 mg bid
Atorvastatin 40 mg od
CPG 75 mg od
Lantus Inj. 12 IU, Novorapid Inj. 3x12 IU

Echo findings in 2020

- EF 20%
- E/A 1.69; E/e' 25.8; LAVI 31.7
- Akinetic in basal mid inferoseptal, apical septal, basal mid inferior, apical inferior, basal mid anteroseptal, hypokinetic in other segments
- All chamber dilatation
- MR sev, TR mod
- TAPSE 15 mm

Angiography in March 2020

- LM normal
- LAD CTO in mid LAD
- LCx stenosis 60% in prox, 70-80% in prox OM1
- RCA multiple stenosis 50-70% in prox-mid, diffuse stenosis at distal

PCI with DES at proximal – mid OM1

Staging PCI with DES at proximal LCx

Labs :

- Hb/leu/plt: 13.1/**19.580**/138.000
- GDS: 91
- Ur/Cr: **81/1.5**
- Na/K/Cl: 139/3.8/103
- PCT : **9,5**
- Lactat Acid: **1,8**
- pH/pO₂/pCO₂/HCO₃/BE/TCO₂/SaO₂
7.41/201/**17/10.8**/**-11.4**/11.3/100

Working Diagnose

- ADHF wet and warm
- Sepsis ec Pneumonia Community
- CAD post PCI (2020)
- HHD
- DM tipe 2

- Bed rest
- O2 3-4 lpm NK
- IVFD NaCl 0.9% 10 gtt/i
- Drips Furosemid 10 mg/hour
- Ramipril 2,5mg b.i.d
- Dapaglifozin 10 , o.d
- Spironolakton 100 mg, o.d
- Clopidogrel 75 mg , o.d
- Digoksin 0.25 , o.d
- Atorvastatin 40 , o.d
- Postpone Beta-blocker
- Consult Pulmonary Department:
 - Inj. Levofloxacin 750 mg o.d.
 - NAC 200 mg t.i.d
 - Retaphyl 300mg b.i.d
 - Nebul Ventolin 1 resp. t.i.d
 - Metilprednisolon 8 mg t.i.d

Day 1

SOB (+)

BP: 80/40

HR: 80 x/l

RR: 24 x/l

UOP: 1700 cc/ 24 jam

Planning?

- A. Reducing diuretic?
- B. Reducing ACE-i?
- C. Postponing ACE-i?
- D. Postponing beta-blocker?
- E. Postponing MRA?

- Drips Furosemide 10 mg/hour
- Initiate Drips Dobutamine 5mcg/kg/l
- Initiate Drips N-Epi 0,05mcg/kg/l
- Delay Ramipril
- Spironolactone 100 mg, o.d
- Clopidogrel 75 mg , o.d
- Digoksin 0.25 , o.d
- Atorvastatin 40 , o.d
- Dapaglifozin 10mg, o.d
- Insulin Novorapid 10-10-10 IU
- Insulin Lantus 0-0-10 IU

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Day 2

SOB (+)

BP: 90/70

HR: 96 x/l

RR: 24 x/l

UOP: 1600 cc/ 24 jam

**Haemodynamic Echo with support drips
dobu 5 mcg/kgbb/i dan NE 0,05mcg/kgbb/i**

- E/A: couldn't assessed, multiple PVC
- SV: 36,73ml , CO: 3526ml/min, SVR: 1565 dyne sec cm⁻⁵

Lab:

- Hb/Ht/Leu/Plt: 13.4/40.2/6.260/135.000
- Na/K/Cl/Mg/Ca: 142/3.9/106/2.49/8.7
- pH/pO₂/pCO₂/HCO₃/BE/TCO₂/SaO₂: 7.20/90/25/10.7/-15/11.5/-15/11.5/95
- **PCT: 2.51**
- **Ur/Cr: 101/2.02**
- GDS: 183

Next Planning?

- A. Escalating Diuretic?
- B. Re-initiate ACE-i?
- C. Switching ACE-i?**
- D. Initiating beta-blocker?

- Drips Furosemide 10 mg/hour
- Drips Dobutamine 5mcg/kg/l ☐ tapering down
- Drips Norepinephrine 0,05mcg/kg/l ☐ stop
- Drips Bicarbonate Sodium 50mEq
- Initiate Sacubitril/Valsartan 25mg b.i.d
- Clopidogrel 75 mg , o.d
- Digoksin 0.25 , o.d
- Atorvastatin 40 , o.d
- Insulin Novorapid 10-10-10 I & Insulin Lantus 0-0-10 IU
- Dapaglifozin 10mg, o.d.

Day 6

SOB decrease

BP: 80/60

HR: 92 x/l

RR: 20 x/l

UOP: 1500 cc/ 24 jam

Warm extremities

Lab:

- Lab:
- Hb/Ht/Leu/Plt: 14.4/43.4/6.440/180.000
- Ca/Na/K/Cl/Mg: 8.6/138/3.9/4.1/106/1.59
- pH/pO₂/pCO₂/HCO₃/BE/TCO₂/SaO₂: 7.46/110/41/29.2/4.9/30.5/99
- GDS: 169

- Drips Dobutamine 3mcg/kg/l ->stop
- Inj. Furosemide 40mg, bolus intermittent
- Sacubitril/Valsartan 25mg b.i.d
- Spironolactone 100mg o.d.
- Clopidogrel 75 mg , o.d
- Digoksin 0.25 , o.d
- Atorvastatin 40 , o.d
- Insulin Novorapid 10-10-10 I & Insulin Lantus 0-0-10 IU
- Dapaglifozin 10mg, o.d.

Day 8

SOB was not found

BP: 80/60

HR: 88 x/l

RR: 20 x/l

UOP: 1400 cc/ 24 jam

Oedema pretibial (-)

Warm extremities

Predischarge Plan?

- A. Uptitrating ARNI
- B. Initiate beta blocker?**
- C. Initiatie ivabradine?
- D. Diuretic

- Furosemide Tablet 40mg
- Sacubitril/Valsartan 25mg b.i.d ☐
Uptitrate at Outpatient clinic
- Spironolactone 100mg o.d.
- Clopidogrel 75 mg o.d
- Digoxin 0.25 o.d
- Atorvastatin 40 o.d
- Insulin Novorapid 10-10-10 IU &
Insulin Lantus 0-0-10 IU
- Dapaglifozin 10mg o.d.
- Carvedilol 3.125 mg b.i.d
- Plan to Discharge

Mr. HK. 64 years old

Case #2

Chief Complaint : DOE for the last 1 month, aggravated by heavy activity, improved by resting

Routinely control to cardiologist due to CHF and consume medicines prescribed for it

Previous Diseases: DM type 2

Previous Used Drugs:

Platogrix 75 mg

Uperio 25 mg o.d

Rosuvastatin 20 mg

Xigduo (Dapaglifozin 10/Metformin 1000)

KSR 600 mg

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Mr. J. 64 years old

Vital Signs

BP : 90/45
HR : 103 x/i
RR : 20 x/i
SaO₂ : 99%

Physical exam

- JVP R+2 cmH₂O
- Minimal Rhales (+)
- No ascites or oedema on both legs

Labs

- Hb/Ht/Leu/plt:
12.2/32.9/8,200/619,000
- GDS: 130
- Ur/Cr: **33/1.49** (CrCl 53 ml.min)
- Na/K/Cl: 142/4.2/102
- Chol total/LDL/HDL/TG:
231/278/24/210

Echocardiography

Reduced LVEF, EF 35%
Wall motion: RWMA (+)
Diastolic dysfunction grade I (E/A 1,05, E/e' 8,6)
Dimension heart chamber: concentric LVH
Valves: mild MR
Normal contractility of RV (TAPSE 21 mm)

Echo hemodinamik

TD 90/70
MAP 76
HR 85
E/A 1,05
E/e' 8,6
VTI 12
IVC 12/9
RAP 8
SV 37.68
CO 3202
SVR 1698
Kesan Low CO, High SVR

Diagnosis

CHF FC III ec CAD (EF 35%)
Type 2 Diabetes Mellitus
Acute kidney injury (CrCl 53 ml/i)

Therapy

Furosemide 1x40 mg
Sacubitril Valsartan 1x25 mg
Bisoprolol 1 x 1,25 mg
Spironolakton 1x25mg
Rosuvastatin 1x20mg
Clopidogrel 1x75mg
Xigduo (dapagliflozin 10 mg/ Metformin 1000 mg) 1x1

1st Follow up After Discharged

Complaint: dyspnea (-),
orthostatic hypotension (-)

Sens: CM

BP: 80/40 mmHg

HR: 98x/i reg

RR: 20 x/i

SaO₂ 99% RA

TVJ: within normal limit

Cor: S1,S2,regular, murmur (-), gallop (-)

Pulmonary sound: vesicular, crackles (-), rh
(-/-)

Abdomen: ascites (-)

Extremities: pretibial edema (-/-)

A.Uptitrating ARNI?

B.Uptitrating beta blocker?

C.Reducing diuretic?

D.Initiating other agent?

E.Continue treatment?

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1st Follow up After Discharged

Complaint: dyspnea (-),
orthostatic hypotension (-)

Sens: CM

BP: 80/40 mmHg

HR: 98x/i reg

RR: 20 x/i

SaO₂ 99% RA

TVJ: within normal limit

Cor: S1,S2,regular, murmur (-), gallop (-)

Pulmonary sound: vesicular, crackles (-), rh
(-/-)

Abdomen: ascites (-)

Extremities: pretibial edema (-/-)

Furosemide 1x40 mg

Sacubitril Valsartan 2x12.5 mg

Bisoprolol 1 x 1,25 mg

Spironolakton 1x25mg

Rosuvastatin 1x20mg

Clopidogrel 1x75mg

Xigduo (dapagliflozin 10 mg/ Metformin
1000 mg) 1x1

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Follow up in the next month

Complaint: dyspnea (-),
orthostatic hypotension (-)

Sens: CM

BP: 80/40 mmHg

HR: 98x/i reg

RR: 20 x/i

SaO2 99% RA

TVJ: within normal limit

Cor: S1,S2,regular, murmur (-), gallop
(-)

Pulmonary sound: vesicular, crackles (-
, rh (-/-)

Abdomen: ascites (-)

Extremities: pretibial edema (-/-)

Furosemide 1x40 mg ☐ stop

Sacubitril Valsartan 2x25 mg

Bisoprolol 1 x 1,25 mg

Spironolakton 1x25mg

Rosuvastatin 1x20mg

Clopidogrel 1x75mg

Xigduo (dapagliflozin 10 mg/
Metformin 1000 mg) 1x1

What's Next..?

A. Uptitrating ARNI?

B. Uptitrating beta blocker?

C. Reducing diuretic?

D. Introducing ivabradine?

E. Continue treatment?

Follow up in the next 2 month

Complaint: dyspnea (-), orthostatic hypotension (-)

Sens: CM

BP: 87/45 mmHg

HR: 94x/i reg

RR: 20 x/i

SaO₂ 99% RA

TVJ: within normal limit

Cor: S1,S2,regular, murmur (-), gallop (-)

Pulmonary sound: vesicular, crackles (-), rh (-/-)

Abdomen: ascites (-)

Extremities: pretibial edema (-/-)

Uperio (Sacubitril Valsartan) 2x25 mg

Bisoprolol 1 x 5 mg

Spironolakton 1x25mg

Rosuvastatin 1x20mg

Clopidogrel 1x75mg

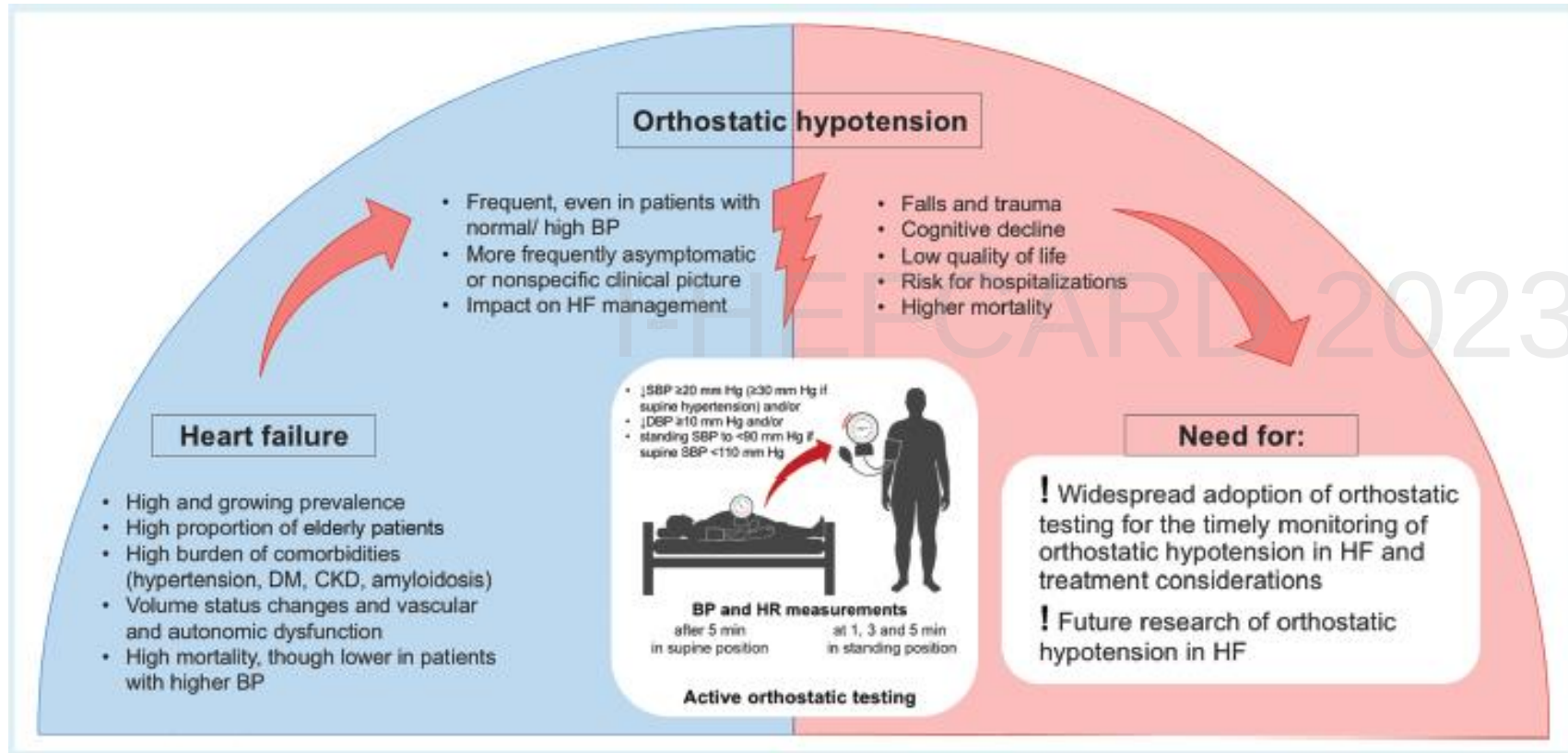
Xigduo (dapagliflozin 10 mg/ Metformin 1000 mg) 1x1

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Defining Low BP

- SBP : 85 – 100 mmHg
- Blood pressure to be used with the clinical context
- Connect low BP with symptoms when it comes to stopping or reducing GDMT

Orthostatic Hypotension



- Intertwined pathophysiology with HF (volume status; vascular & autonomic dysfunction)
- Symptoms confused with HF symptoms
- What matters low BP and symptoms!

Prevalence of Low BP in HF Trials

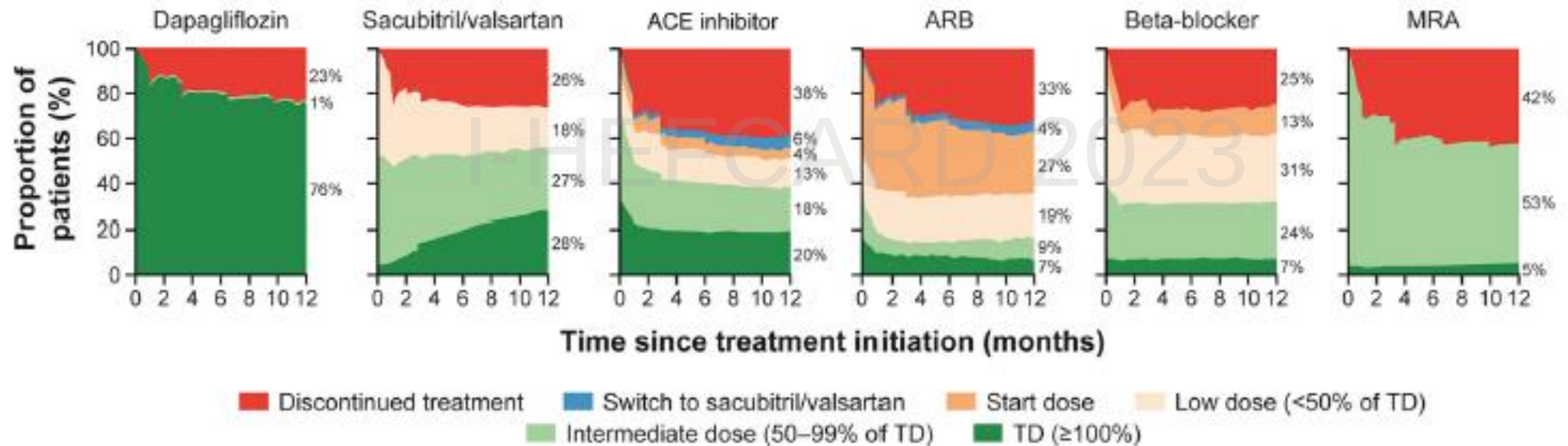
- COPENNICUS : 17.3% (SBP <105 mmHg)
- RALES & EMPHASIS-HF : 16% (SBP <105 mmHg)
- PARADIGM-HF : 21% (SBP <110 mmHg)
- DAPA-HF : 25% (SBP <110 mmHg)

Registries

- CHAMP HF : 22% (SBP <110 mmHg)

Titration to Target Dose and Discontinuation: Real World Data

Among New Users of GDMT After hHF



Savarese et al. J Am Coll Cardiol HF Vol.11, No.1. 2023

Titration to Target Dose and Discontinuation: Real World Data

GDMT in CHAMP-HF and CHECK-HF According to Blood Pressure

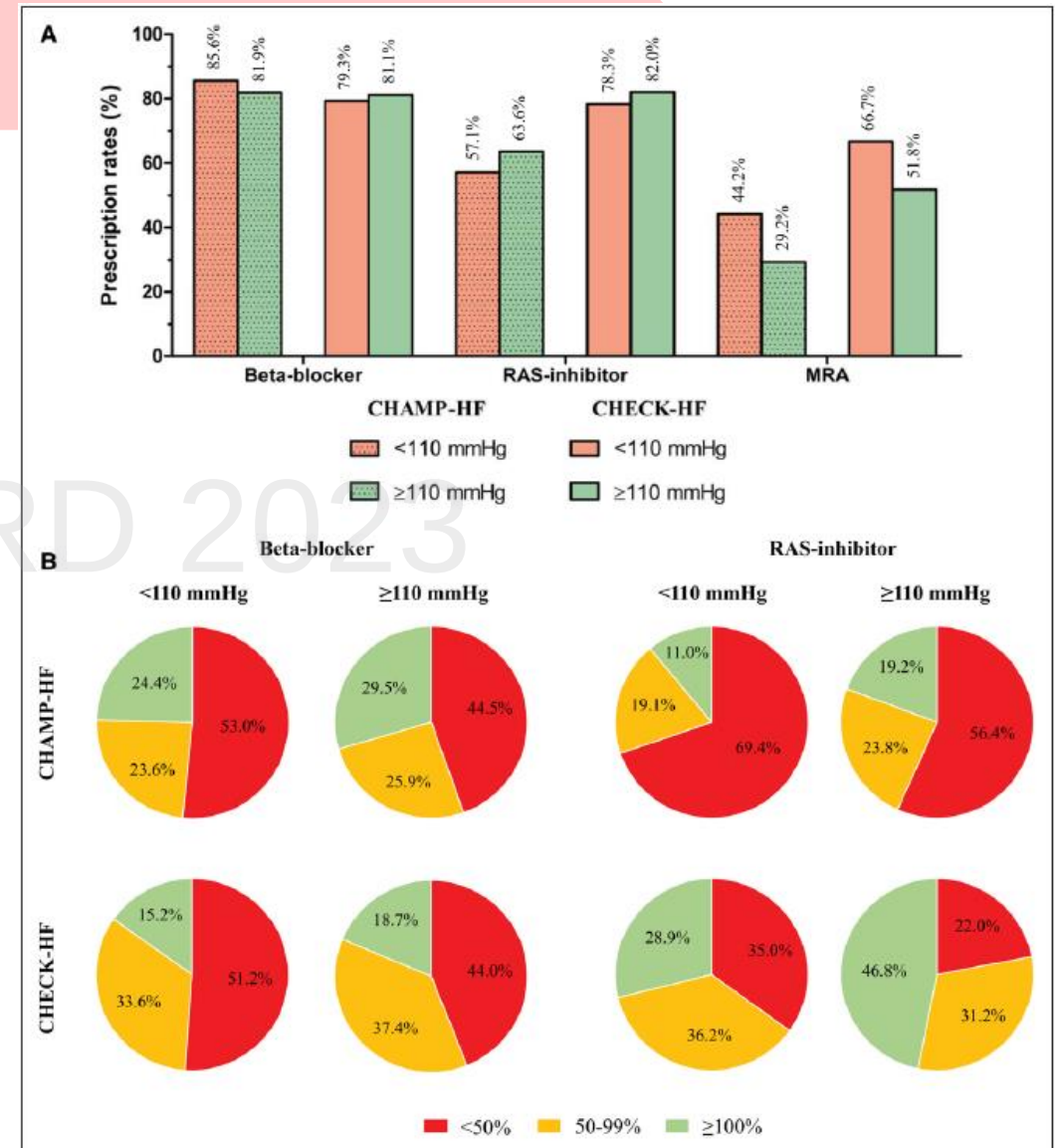


Table 3. Reasons for Not Prescribing HF Medication According to Systolic Blood Pressure

	Contraindicated or Intolerance	No Reason Specified	P Value
β-Blocker			
Total population	259 (16.1)	1350 (83.9)	0.73
Systolic BP <95	13 (18.1)	59 (81.9)	
Systolic BP 95–109	40 (15.7)	215 (84.3)	
Systolic BP 110–129	93 (15.0)	528 (85.0)	
Systolic BP ≥130	113 (17.1)	548 (82.9)	
RAS inhibitors			
Total population	376 (24.7)	1144 (75.3)	0.002
Systolic BP <95	32 (41.6)	45 (58.4)	
Systolic BP 95–109	71 (27.3)	189 (72.7)	
Systolic BP 110–129	141 (23.2)	468 (76.8)	
Systolic BP ≥130	132 (23.0)	442 (77.0)	
MRA			
Total population	383 (10.1)	3427 (89.9)	0.019
Systolic BP <95	14 (12.6)	97 (87.4)	
Systolic BP 95–109	45 (10.7)	376 (89.3)	
Systolic BP 110–129	164 (11.7)	1239 (88.3)	
Systolic BP ≥130	160 (8.5)	1715 (91.5)	

Veenis et al. Circ Heart Fail. 2020

Low BP-HFrEF

Newly Diagnosed

- Younger
- Lower ejection fraction
- Less likely ischemic aetiology
- Less likely DM/HT
- Longer HF duration
- Better NYHA

Known HF-During Uptitration Phase

- Higher age
- Low SBP at baseline
- No history of hypertension
- Hyponatremia
- CKD
- An increase in diuretic dose in the previous week
- NYHA Class IV
- Persistent signs of congestion requiring high dose of diuretics or vasodilators

Known HF Maintained on GDMT

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Low BP – Heart Failure

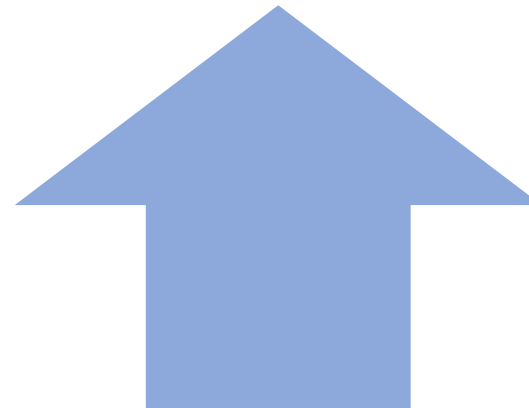


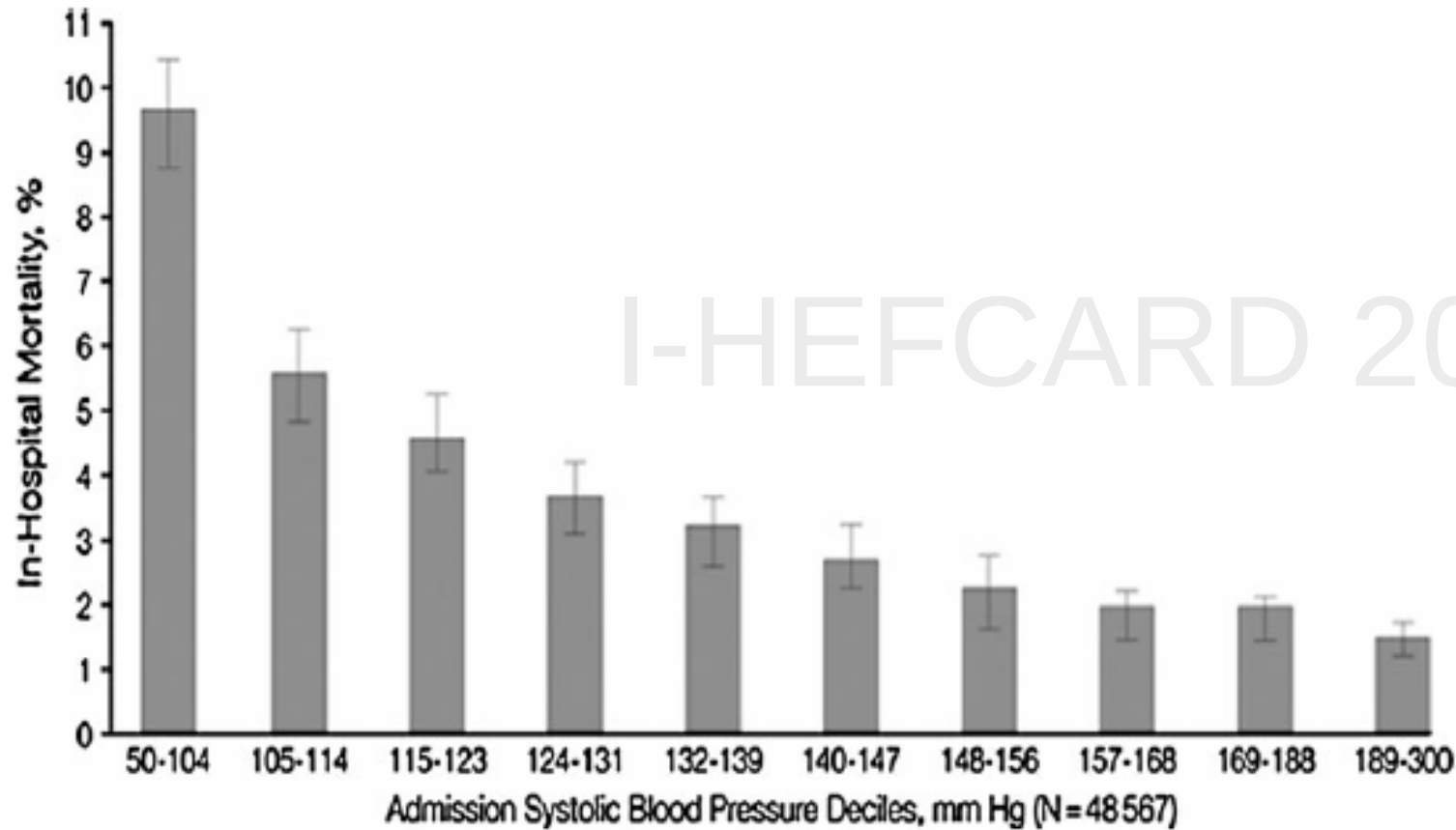
**Optimal Therapy –
Great Benefit**

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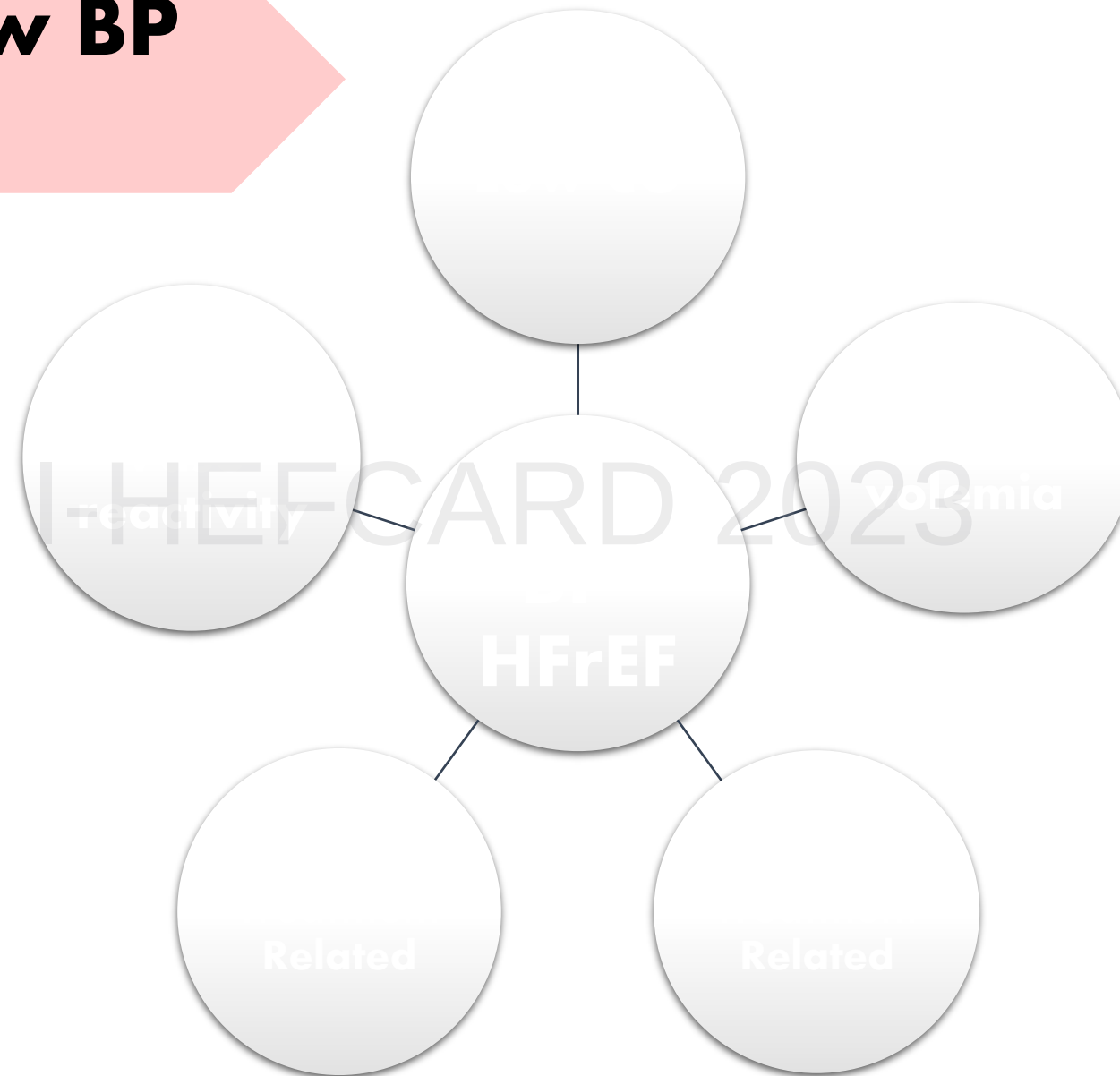
- **Low CO** □ **impaired perfusion**
- **High risk mortality**
- **Therapy reduces BP**





In-hospital all-cause mortality as a function of admission systolic blood pressure based on data from OPTIMIZE-HF

Causes of Low BP in HFrEF



Hypotension as Side Effect of HF Treatment?

Prevalence of Low BP in Trials

- **COPERNICUS** : 17.3% (SBP <105 mmHg)
- **RALES & EMPHASIS-HF** : 16% (SBP <105 mmHg)
- **PARADIGM-HF** : 21% (SBP <110 mmHg)
- **DAPA-HF** : 25% (SBP <110 mmHg)
- **CHAMP HF** : 22% (SBP <110 mmHg)

Which Agent Should Be Initiated First?

- Historical evidence : benefit ACEI preceded evidence from BB
- Recent data : suggest it may be safe to initiate BB before ACEI
- Individualized in challenging patients with low BP

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- BB with vasodilatory or α -blocker may slightly more BP lowering.

BB without vasodilatory may be easier to use

- ACEI short acting may allow smaller but more frequent doses for uptitrate

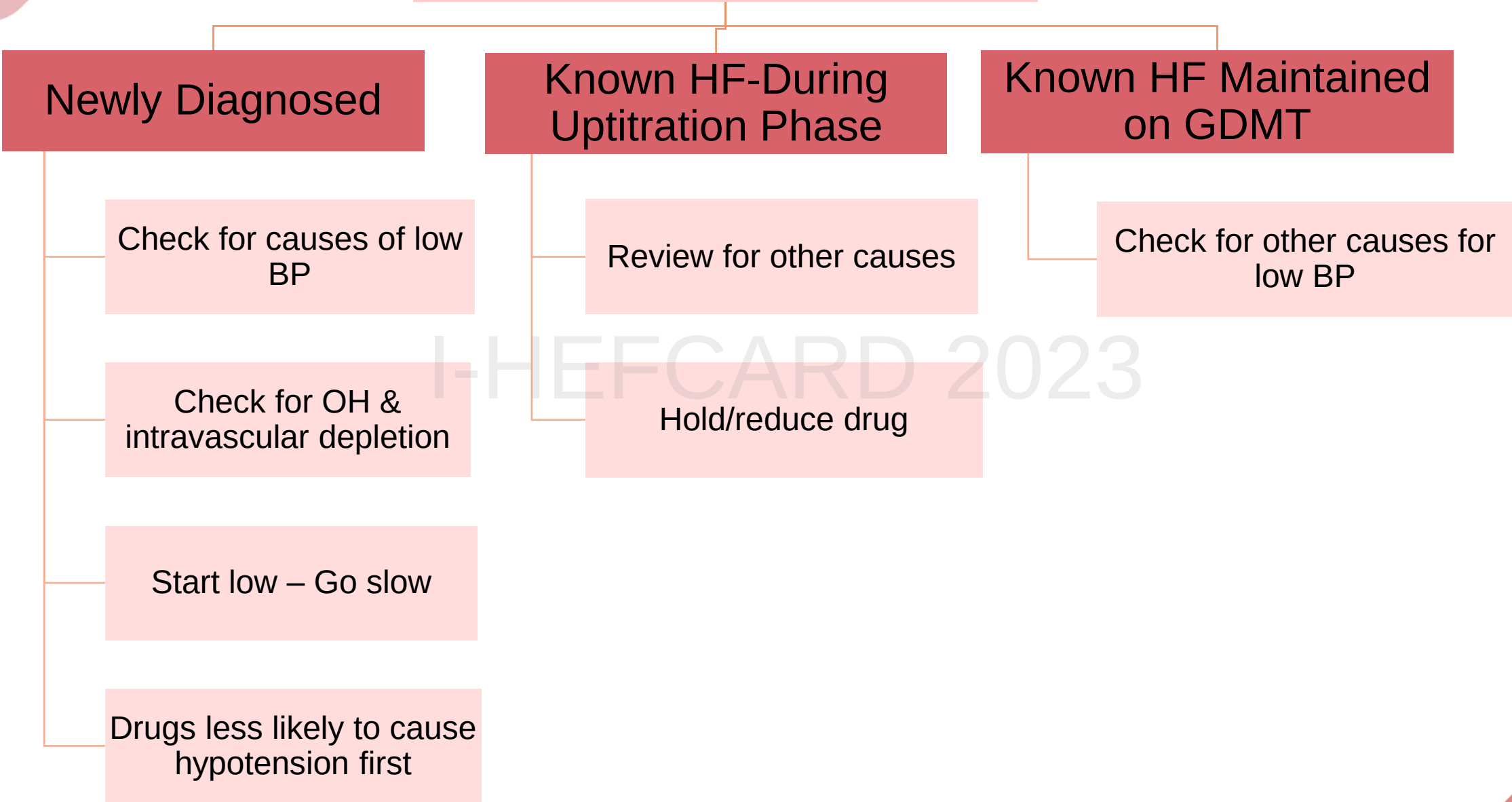
Should the Dose of an Agent Be Increased Before Initiating Another?

- Titrating to **target dose** ☐ more benefit than very low dose
- Efficacy between intermediate and high dose ☐ small difference ☐ if target dose can't be achieved, intermediate dose can be used
- Start BB after intermediate dose ACE-I are achieved (vice versa)

Which Drug Should be Decreased?

- **Medications** for indications **other than HF** should be closely examined for side effects of hypotension ☐ adjusted or discontinued if possible (CCB, α -blocker, nitrates, phosphodiesterase-5 inhibitor)
- Change **dosing time** of medications ☐ spaced apart from each other may be better tolerated
- Adjustment or lowering diuretics

Low BP-HFrEF



Tailoring medical therapy according to clinical profiles



Effects by Drugs Class

Treatment class ^a	RRR death	RRR hospitalization	BP†‡	HR†‡	GFR†	Serum K†‡
Loop diuretic	?	?	↓	↔	↓	↓↓
evBB	↑↑↑↑	↑↑↑↑	↓	↓↓↓	↓	↓
RAi						
ACEi	↑↑↑	↑↑↑	↓↓	↔	↓↓	↑↑
ARB	↑↑↑	↑↑↑	↓↓	↔	↓↓	↑↑
ARNi	↑↑↑↑	↑↑↑↑	↓↓↓	↔	↓↓	↑↑
MRA	↑↑↑↑	↑↑↑↑	↓	↔	↔	↑↑↑
H-SDN	↑↑↑↑§	↑↑↑↑§	↓↓	↔	↓ or ↔	↔
Ivabradine	↔	↑↑	↔	↓↓	↔	↔
Digoxin	↔	↑	↔	↓	↔	↔
SGLT2i	↑↑↑↑	↑↑↑↑	↔	↔	↔	↔
sGC vericiguat	↔	↑↑	↓	↔	↔	↔
Omecamtiv mecarbil	??	??	↑	↔	↑?	↔
K binder	↔	↔	↔	↔	↔	↓↓↓

Table. Strategies in Management of HF Patients With Hypotension

General approaches for most HF patients with low BP

Avoid overuse of medications that cause hypotension, such as α -blockers, calcium-channel blockers, nitrates, PDE-5 inhibitors

Avoid inappropriate overdosing of diuretics

Separate timing of medications that cause hypotension apart from each other

Assess and treat possible noncardiac causes of hypotension

Avoid abrupt withdrawal of ACEI or β -blocker without a compelling clinical indication

Approaches for HF patients with asymptomatic low BP before initiation of HF medications

Initial occasional low BP is usually transient and most patients tolerate HF medications

It is not unreasonable to start β -blockers after intermediate doses of ACEI are achieved

Initiate and uptitrate GDMT slowly and cautiously with close follow-up

Approaches for patients with HF with asymptomatic low BP after initiation of HF medications

Do not reduce or discontinue ACEI or β -blockers for asymptomatic low BP measurements

With improvement of HF status with GDMT and/or CRT, BP profile usually improves

HF patients with symptomatic hypotension

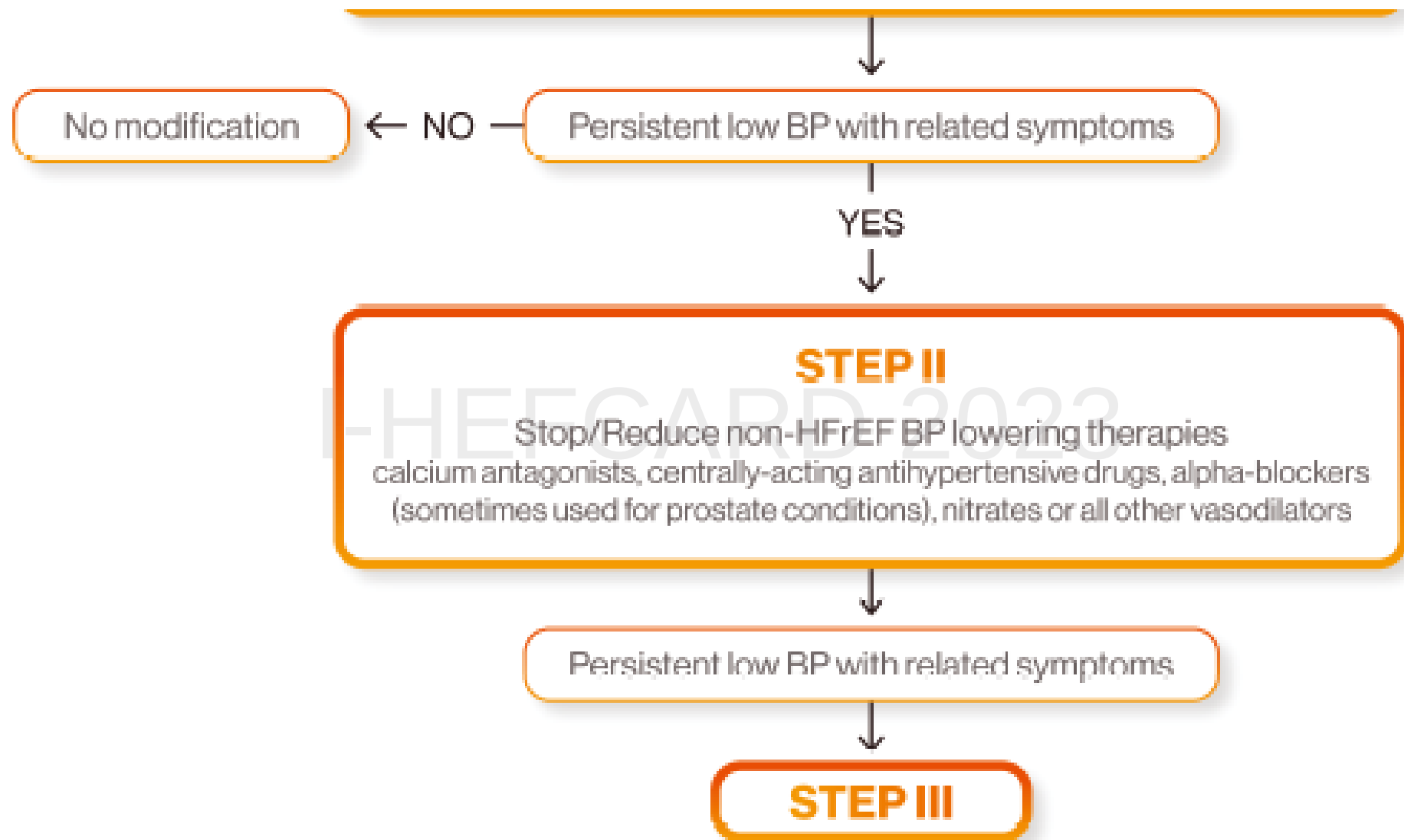
Hypotension may be because of advanced systolic HF and/or noncardiac causes

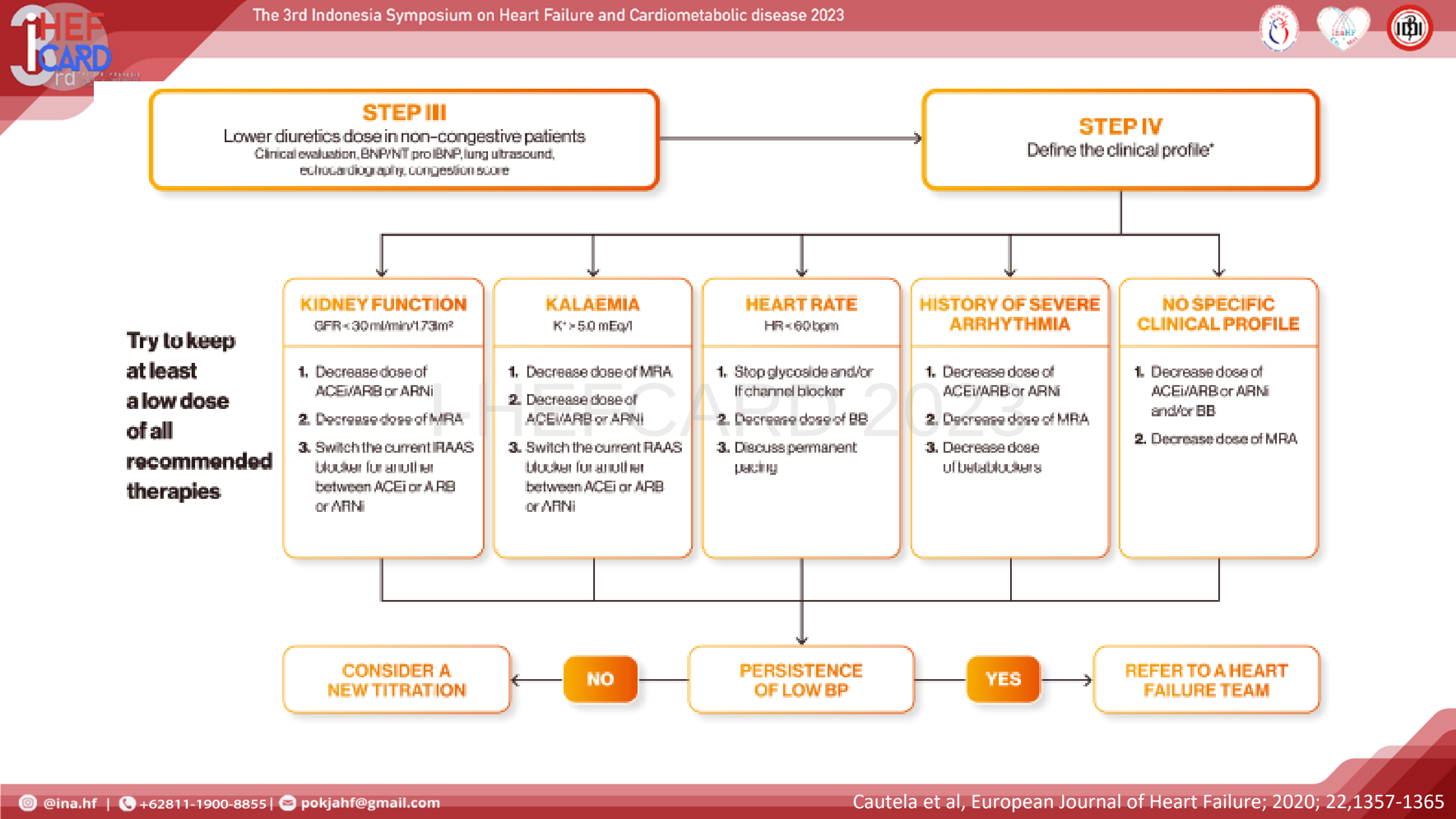
Initial occasional hypotension or dizziness usually resolves as HF improves with GDMT and/or CRT

Additional HF medications may need to be adjusted before consideration of any changes in ACEI or β -blockers

BP indicates blood pressure; HF, heart failure; PDE-5 inhibitors, phosphodiesterase-5 inhibitors such as sildenafil; GDMT, guideline-directed medical therapy; ACEI, angiotensin converting enzyme inhibitors; CRT, cardiac resynchronization therapy.







Take Home Messages

- Choose the initiation sequence that suits your patient
- Start low, go slow, aim high
- Uptitrate to maximal tolerated of GDMT
- Make all efforts not to reduce or discontinue GDMT drugs



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Thank You

