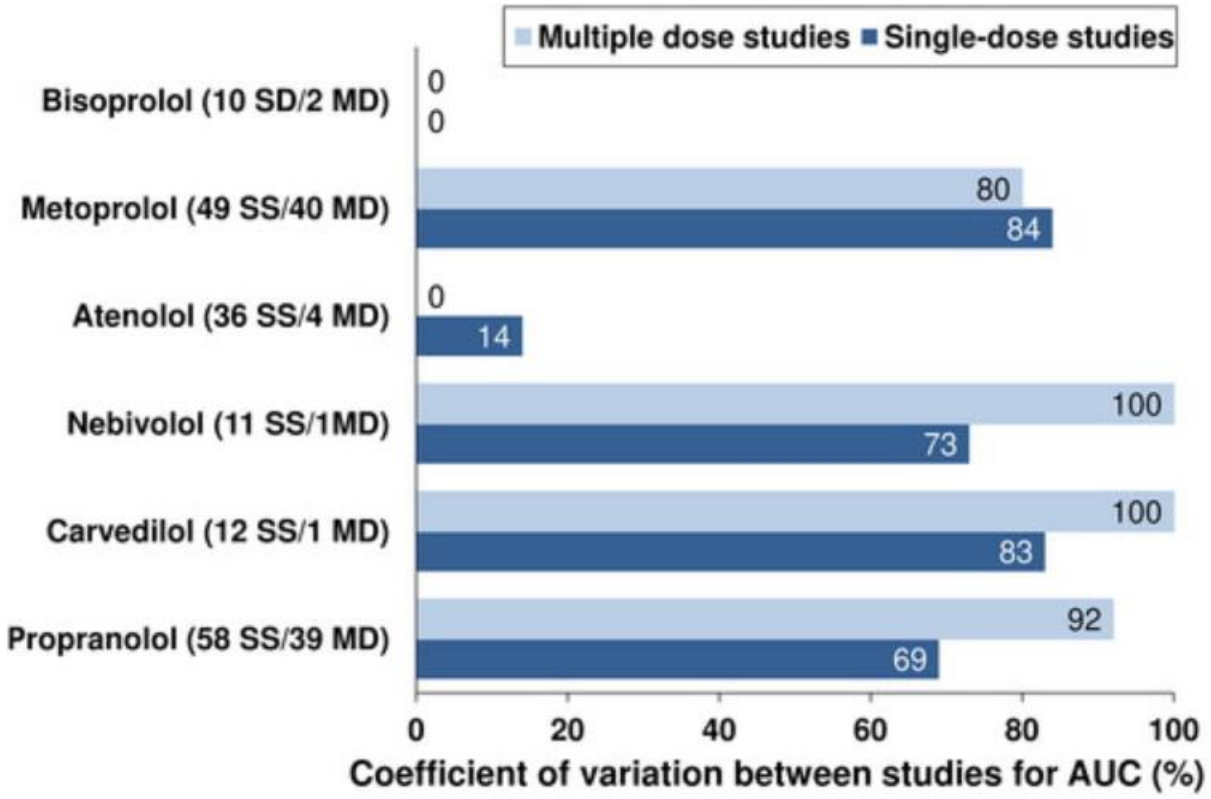
Beta Blockers

	Cardioselective	Non-selective
Blocker		Propranolol
	Atenolol	Sotolol (Renal)
	Metoprolol	
	Bisoprolol	
		Carvedilol (α Blocker)
Partial Agonist	Nebivolol (β^3 agonist)	Labetalol (α Blocker)

AUC Variability

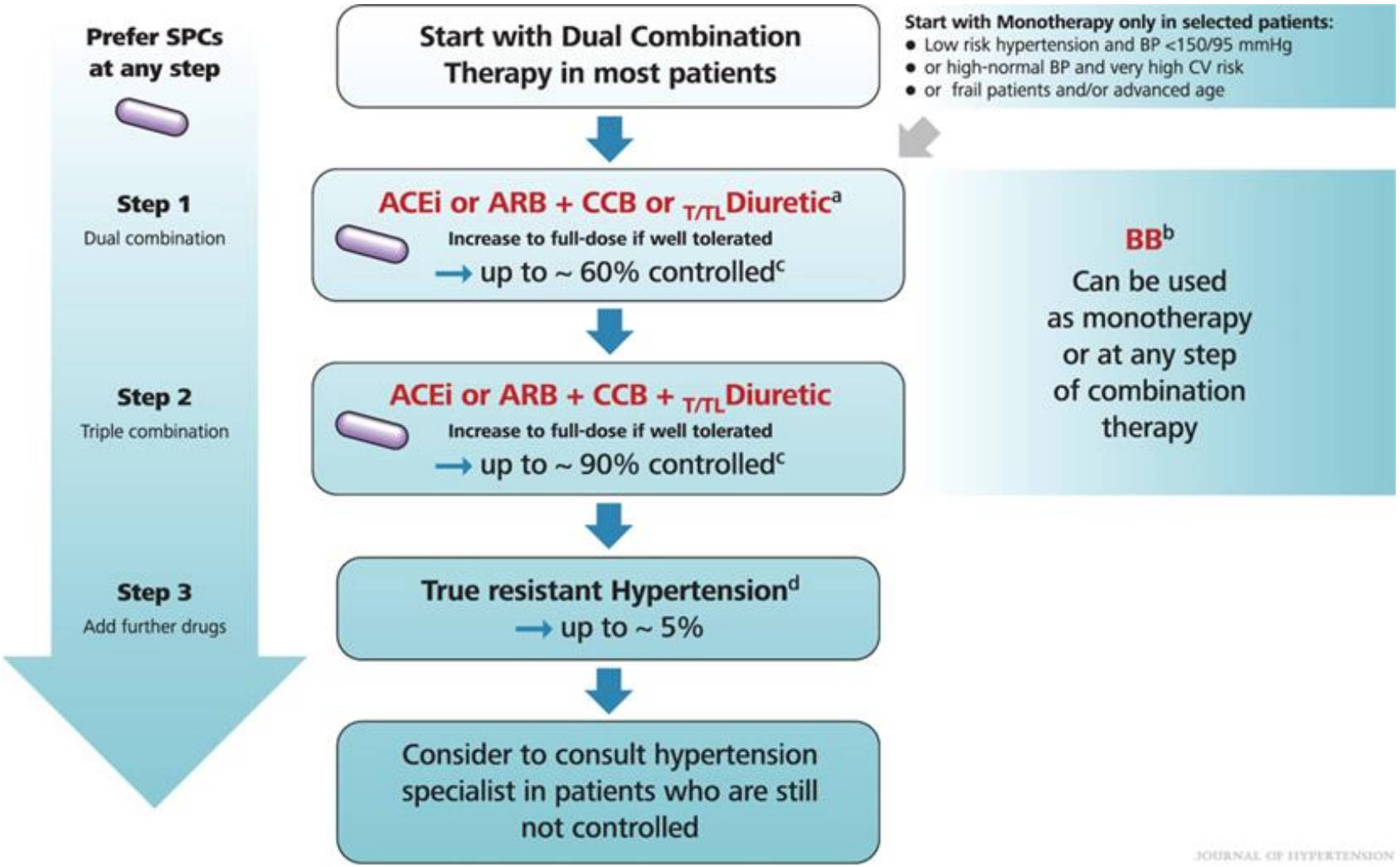


Stefano Taddei, β-blockers are not all the same: pharmacologic similarities and differences, potential combinations and clinical implications. Current Medical Reasearch and Opinion, Vol 40, Issue 1

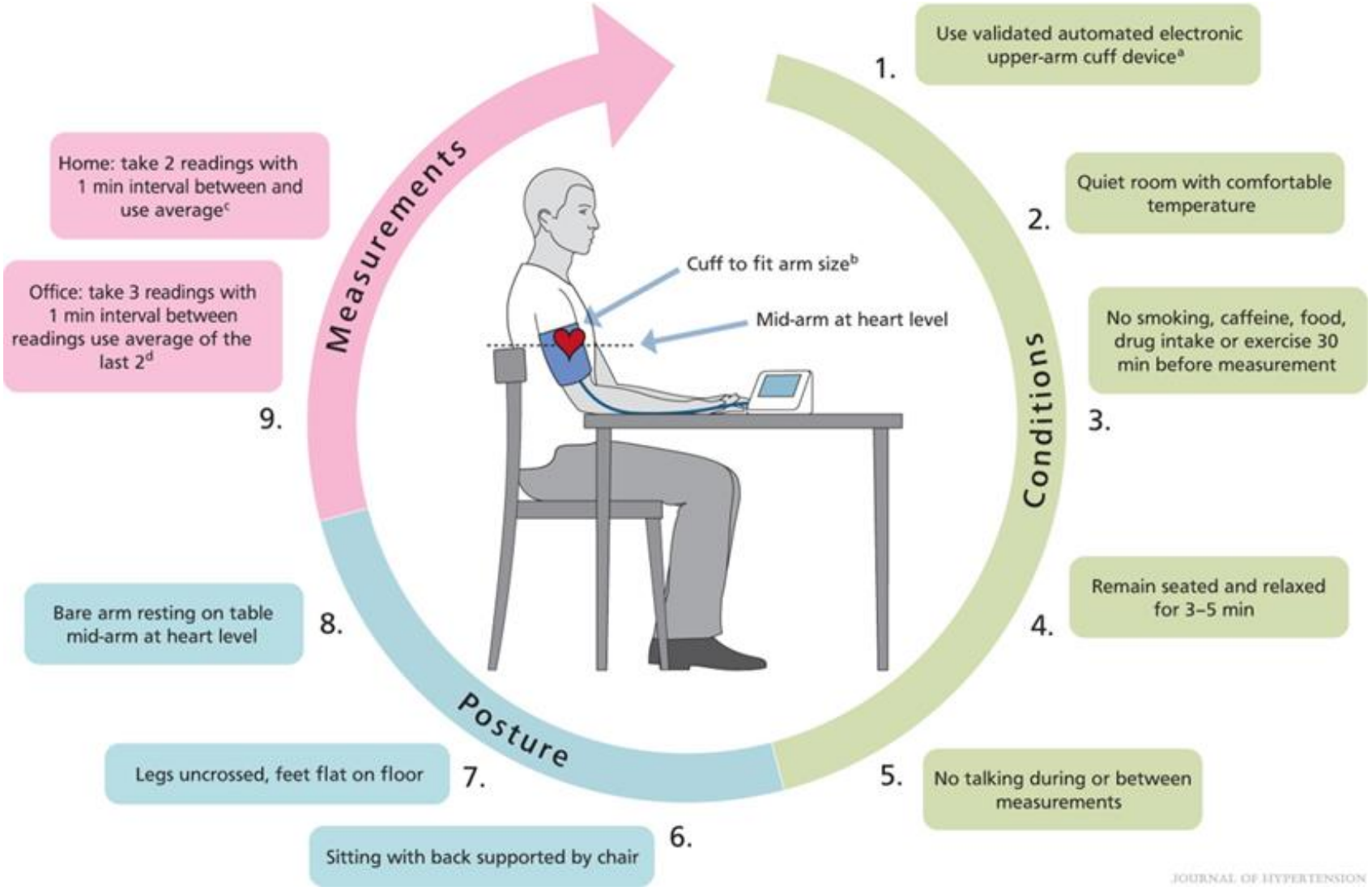
Beta Blocker Indications

Hypertension
HFrEF
Ischaemic heart disease - angina, AMI
Tachyarrhythmias – SVT, VT, AF, atrial flutter
Palpitations
Anxiety
Essential tremor
Migraine
Glaucoma
Thyrotoxicosis
Portal hypertension

European Society of HTN 2023



European Society of HTN 2023



European Society of HTN 2023

Category	SBP (mmHg)		DBP (mmHg)
Office BP[a]	≥140	and/or	≥90
Ambulatory BP			
Daytime (or awake) mean	≥135	and/or	≥85
Night-time (or asleep) mean	≥120	and/or	≥70
24 h mean	≥130	and/or	≥80
Home BP mean	≥135	and/or	≥85

BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.
[a]Refers to conventional office BP rather than unattended office BP.

JOURNAL OF HYPERTENSION

Beta Blocker Indications

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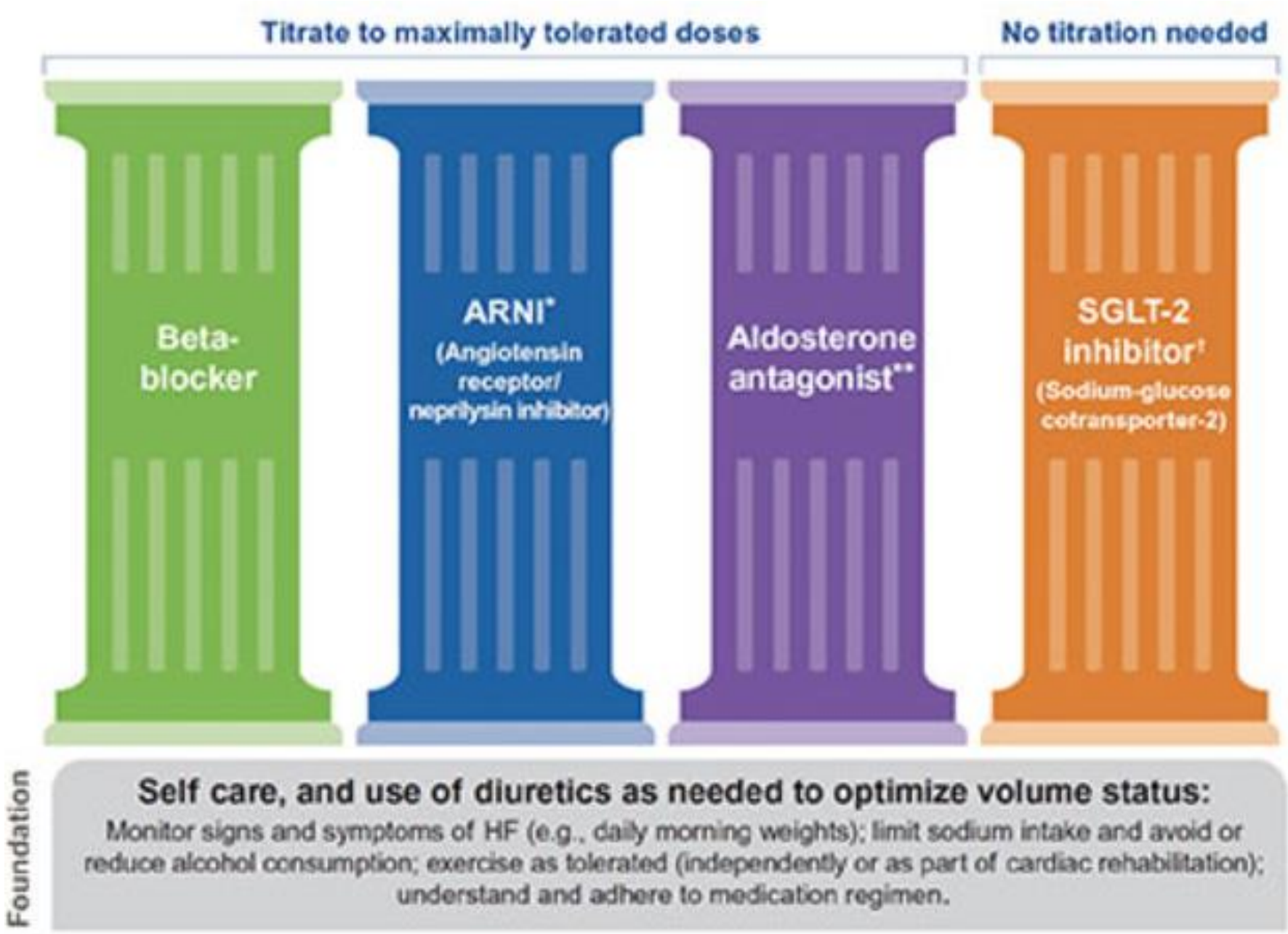
Palpitations
Anxiety
Essential tremor
Migraine
Glaucoma
Thyrotoxicosis
Portal hypertension



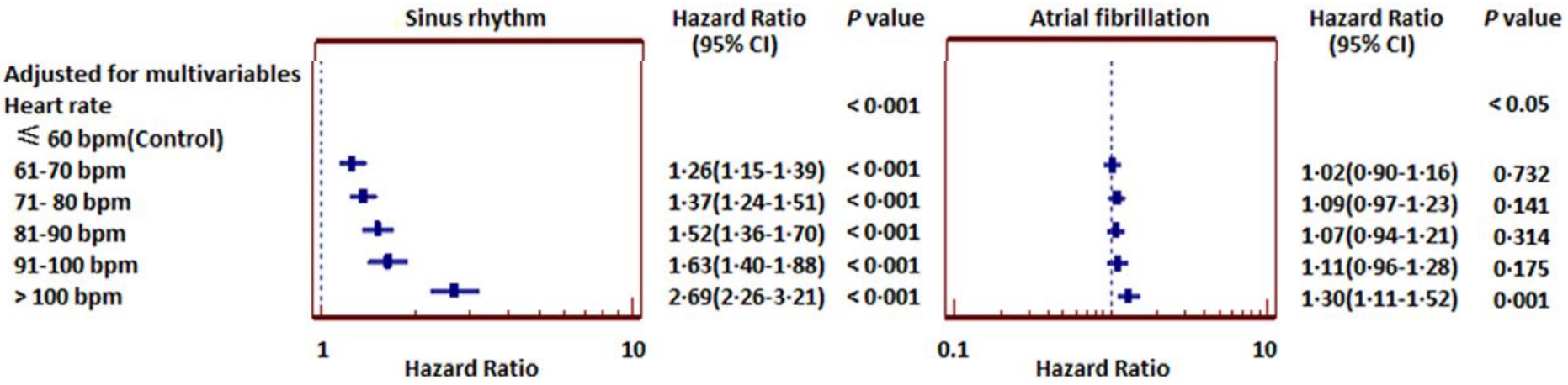
*Can use ACE inhibitor or ARB if unable to afford or tolerate ARNI. **Also known as mineralocorticoid receptor antagonist (MRA). †Dapagliflozin and empagliflozin were studied at 10 mg daily.

Prognostic Significance of Resting Heart Rate and Use of β-Blockers in Atrial Fibrillation and Sinus Rhythm in Patients With Heart Failure and Reduced Ejection Fraction: Findings From the Swedish Heart Failure Registry

Shi-Jun Li, MD, PhD, Ulrik Sartipy, MD, PhD, Lars H. Lund, MD, Ulf Dahlström, MD, PhD, Martin Adiels, PhD, Max Petzold, MD, and Michael Fu, MD, PhD | AUTHOR INFO & AFFILIATIONS

Circulation: Heart Failure • Volume 8, Number 5 • https://doi.org/10.1161/CIRCHEARTFAILURE.115.002285

Swedish Heart Failure Registry



Swedish heart Failure Registry

Table 3. Cox Regression Analyses for the Association of β-Blockers With Mortality in Sinus Rhythm and Atrial Fibrillation Subgroups

	No. of Deaths/Patients (% Per Person-Year)	Univariable Hazard Ratio (95% CI)	*P* Value	Multivariable Hazard Ratio (95% CI)	*P* Value
In sinus rhythm					
β-Blockers (yes vs no)	3347/10 291 (10.6%)	0.56 (0.52–0.62)	<0.001	0.77 (0.63–0.94)	0.011
In atrial fibrillation					
β-Blockers (yes vs no)	2835/6739 (15.7%)	0.52 (0.47–0.58)	<0.001	0.71 (0.61–0.84)	<0.001

Multivariable Cox regression was performed with the variables listed in Table 1 except atrial fibrillation. CI indicates confidence interval; and HR, heart rate.

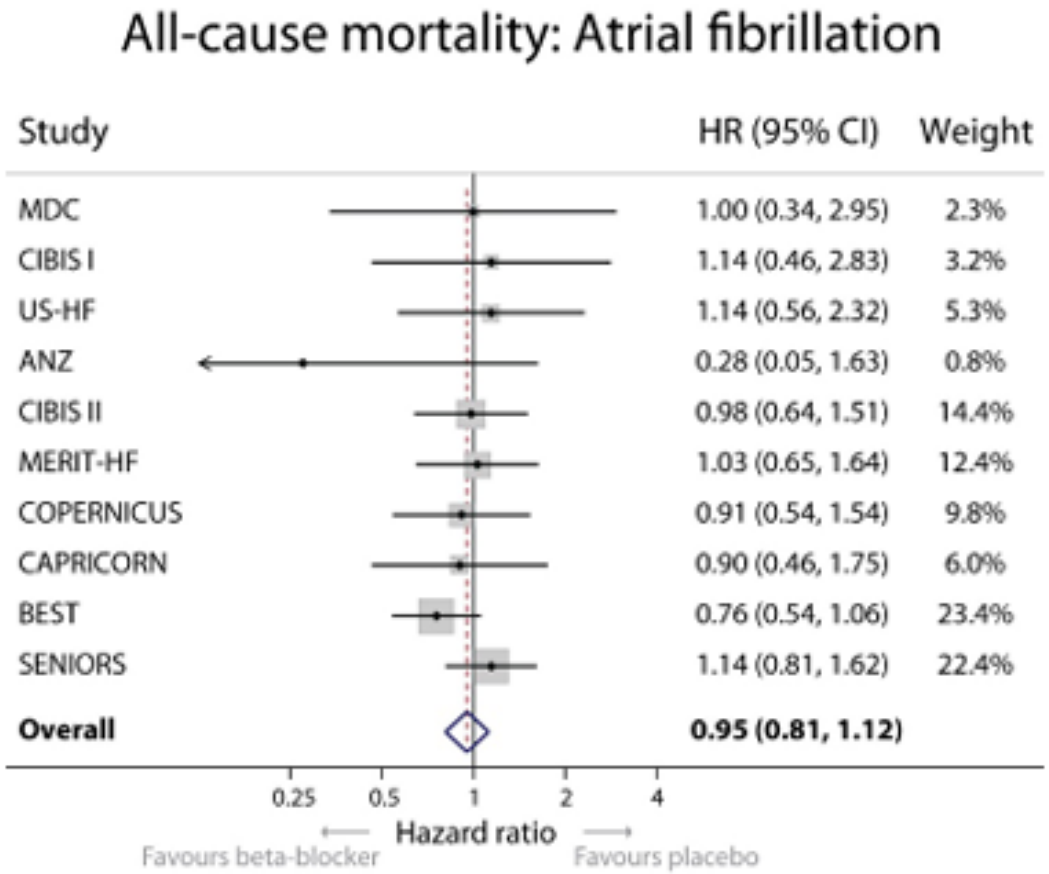
Efficacy of β blockers in patients with heart failure plus atrial fibrillation

Kotecha, Dipak et al, Lancet. 2014;384:2235–2243

Characteristic	Sinus rhythm n=13,946	Atrial fibrillation n=3,066
Age, median years (IQR)	64 (54-71)	69 (60-74)
Women	25.1%	19.4%
Diabetes mellitus	24.6%	23.1%
Years with HF diagnosis, median (IQR)	3.0 (1.0-6.0)	3.0 (1.0-7.0)
LVEF, median % (IQR)	0.27 (0.21-0.33)	0.27 (0.22-0.33)
NYHA class III/IV	62.6%	72.1%
Systolic BP, median mmHg (IQR)	123 (110-140)	127 (113-140)
Diastolic BP, median mmHg (IQR)	78 (70-82)	80 (70-85)
Heart rate, median bpm (IQR)	80 (72-88)	81 (72-92)
Body mass index, median kg/m^2 (IQR)	27 (24-31)	27 (25-31)
Estimated GFR, median mL/min (IQR)	64 (52-78)	61 (49-74)
Any diuretic therapy	85.2%	93.5%
ACEi or ARB	94.7%	94.5%
Aldosterone antagonists	8.2%	16.8%
Digoxin	52.9%	83.5%
Amiodarone	5.7%	10.4%
Oral anticoagulation	26.2%	57.8%

Efficacy of β blockers in patients with heart failure plus atrial fibrillation

Kotecha, Dipak et al, Lancet. 2014;384:2235–2243



Beta Blocker Indications

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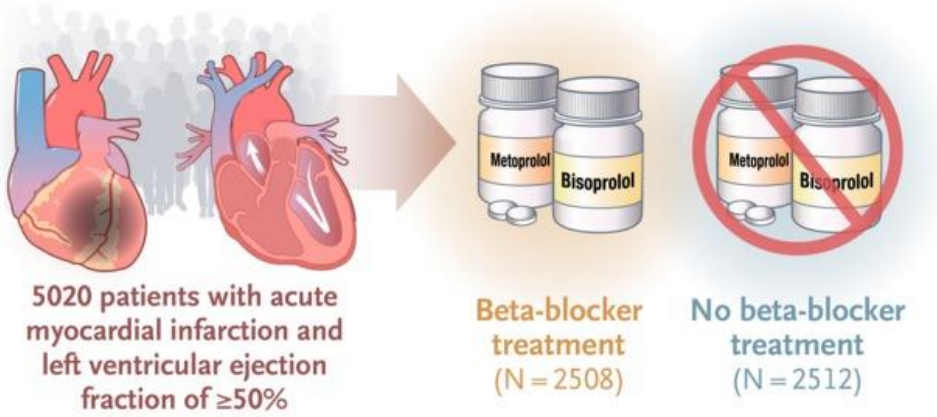
Anxiety
Essential tremor
Migraine
Glaucoma
Thyrotoxicosis
Portal hypertension

Beta-Blockers after Myocardial Infarction and Preserved Ejection Fraction

Yndigegn T et al. DOI: 10.1056/NEJMoa2401479

CLINICAL PROBLEM

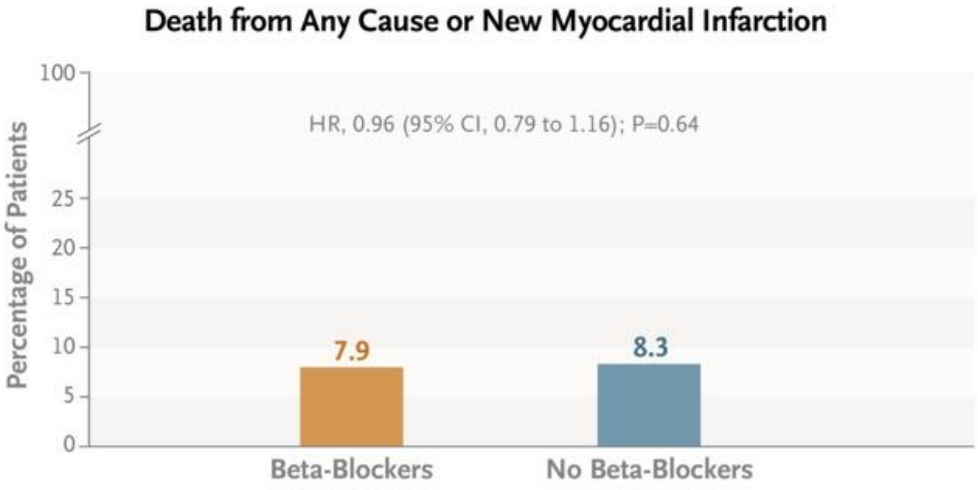
The efficacy of beta-blocker treatment after myocardial infarction is well documented; however, most trials included patients with large myocardial infarctions and predated advancements such as modern biomarker-based diagnosis and treatment with percutaneous coronary intervention, antithrombotic agents, high-intensity statins, and renin–angiotensin–aldosterone system antagonists. Data from contemporary, sufficiently powered, randomized trials examining the effect of long-term beta-blocker therapy in patients with an acute myocardial infarction and preserved ejection fraction are lacking.



CLINICAL TRIAL

Design: A registry-based, prospective, open-label, parallel-group, randomized clinical trial that was performed at 45 centers in Sweden, Estonia, and New Zealand evaluated the efficacy and safety of long-term oral beta-blocker treatment initiated early in patients with an acute myocardial infarction and preserved left ventricular ejection fraction.

Intervention: 5020 patients (95% of whom were from Sweden) with an acute myocardial infarction who had undergone coronary angiography and had a left ventricular ejection fraction of ≥50% were assigned to beta-blocker treatment (metoprolol or bisoprolol) or no beta-blocker treatment. The primary end point was a composite of death from any cause or new myocardial infarction.



Safety

Table 1. Characteristics of the Patients.*

Characteristic	Beta-Blockers (N=2508)	No Beta-Blockers (N=2512)
Median age (IQR) — yr	65 (57–73)	65 (57–73)
Female sex — no. (%)	563 (22.4)	568 (22.6)
Country — no. (%)		
Sweden	2392 (95.4)	2396 (95.4)
Estonia	16 (0.6)	16 (0.6)
New Zealand	100 (4.0)	100 (4.0)
Risk factors — no./total no. (%)		
Current smoking	478/2466 (19.4)	530/2483 (21.3)
Hypertension	1155/2507 (46.1)	1163/2509 (46.4)
Diabetes mellitus	346/2506 (13.8)	354/2509 (14.1)
Previous cardiovascular disease — no./total no. (%)		
Previous myocardial infarction	165/2503 (6.6)	192/2507 (7.7)
Previous PCI	147/2504 (5.9)	175/2505 (7.0)
Previous CABG	33/2504 (1.3)	36/2507 (1.4)
Previous stroke	52/2506 (2.1)	67/2507 (2.7)
Previous heart failure	13/2486 (0.5)	22/2481 (0.9)
Characteristic at presentation		
Chest pain as main symptom — no./total no. (%)	2421/2507 (96.6)	2417/2512 (96.2)
CPR before hospital arrival — no./total no. (%)	10/2483 (0.4)	11/2485 (0.4)

Table 2. Primary and Secondary End Points.*

End Point	Beta-Blockers (N=2508)	No Beta-Blockers (N=2512)	Hazard Ratio (95% CI)†
	number (percent)		
Primary end point			
Death from any cause or myocardial infarction	199 (7.9)	208 (8.3)	0.96 (0.79 to 1.16)
Secondary end points			
Death from any cause	97 (3.9)	103 (4.1)	0.94 (0.71 to 1.24)
Death from cardiovascular causes	38 (1.5)	33 (1.3)	1.15 (0.72 to 1.84)
Myocardial infarction	112 (4.5)	117 (4.7)	0.96 (0.74 to 1.24)
Hospitalization for atrial fibrillation	27 (1.1)	34 (1.4)	0.79 (0.48 to 1.31)
Hospitalization for heart failure	20 (0.8)	22 (0.9)	0.91 (0.50 to 1.66)
Safety end points			
Hospitalization for bradycardia, second- or third-degree atrioventricular block, hypotension, syncope, or implantation of a pacemaker	86 (3.4)	80 (3.2)	1.08 (0.79 to 1.46)
Hospitalization for asthma or COPD	15 (0.6)	16 (0.6)	0.94 (0.46 to 1.89)
Hospitalization for stroke	36 (1.4)	46 (1.8)	6.80 (–7.11 to 20.72)

* For all end points except the composite primary end point and the secondary end point of death from any cause, death bef competing risk, and the analysis shows cause-specific hazards. See the detailed statistical methods in the Supplementary A notes confidence interval, and COPD chronic obstructive pulmonary disease.

† For the safety end point of hospitalization for stroke, the table shows the difference in the restricted mean survival time in largest follow-up time (2224 days), which was a post hoc analysis. Within the largest follow-up time, the restricted mean su 2195 days in the beta-blocker group and 2188 days in the no–beta-blocker group.

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 10, 2024 VOL. 391 NO. 14

Beta-Blocker Interruption or Continuation after Myocardial Infarction

J. Silvain, G. Cayla, E. Ferrari, G. Range, E. Puymirat, N. Delarche, P. Guedeney, T. Cuisset, F. Ivanes, T. Lhermusier, T. Petroni, G. Lemesle, F. Bresoles, J.-N. Labeque, T. Pommier, J.-G. Dillinger, F. Leclercq, F. Boccara, P. Lim, T. Besseyre des Horts, T. Fourme, F. Jourda, A. Furber, B. Lattuca, N. Redjimi, C. Thuaire, P. Deharo, N. Procopi, R. Dumaine, M. Slama, L. Payot, M. El Kasty, K. Aacha, A. Diallo, E. Vicaut, and G. Montalescot, for the ABYSS Investigators of the ACTION Study Group*

Characteristic	Beta-Blocker Interruption (N=1846)	Beta-Blocker Continuation (N=1852)
Demographic and cardiovascular risk		
Age — yr	63.5±11.2	63.5±10.9
Male sex — no. (%)	1530 (82.9)	1531 (82.7)
Median body-mass index (IQR)†	26.3 (23.9–29.4)	26.5 (24.1–29.6)
Current smoker — no. (%)	385 (20.9)	342 (18.5)
Hypertension — no. (%)	786 (42.6)	805 (43.5)
Diabetes — no. (%)	372 (20.2)	375 (20.2)
Dyslipidemia — no. (%)	948 (51.4)	994 (53.7)
Medical history		
ST-segment elevation myocardial infarction — no. (%)	1168 (63.3)	1162 (62.7)
Non–ST-segment elevation myocardial infarction — no. (%)	678 (36.7)	690 (37.3)
Median time from index myocardial infarction to randomization (IQR) — yr	2.9 (1.2–6.2)	2.8 (1.1–6.6)
Multivessel disease — no. (%)	955 (51.7)	979 (52.9)
Revascularization for index myocardial infarction — no./total no. (%)	1755/1846 (95.1)	1757/1852 (94.9)
Completeness‡	1601/1753 (91.2)	1619/1755 (92.1)
Percutaneous coronary intervention	1709/1755 (97.4)	1693/1757 (96.4)
Fibrinolysis	29/1755 (1.7)	46/1757 (2.6)
Coronary-artery bypass grafting	62/1755 (3.5)	83/1757 (4.7)

End Point	Beta-Blocker Interruption (N=1846)	Beta-Blocker Continuation (N=1852)	Risk Difference (95% CI) (percentage points)
	no. of patients with event (%)		
Primary end point	432 (23.8)	384 (21.1)	2.8 (<0.1 to 5.5)
Death	76 (4.1)	74 (4.0)	0.1 (–1.2 to 1.4)
Myocardial infarction	46 (2.5)	44 (2.4)	0.1 (–0.9 to 1.1)
Stroke	18 (1.0)	19 (1.0)	–0.1 (–0.7 to 0.6)
Hospitalization for cardiovascular reason	349 (18.9)	307 (16.6)	2.3 (–0.1 to 4.8)

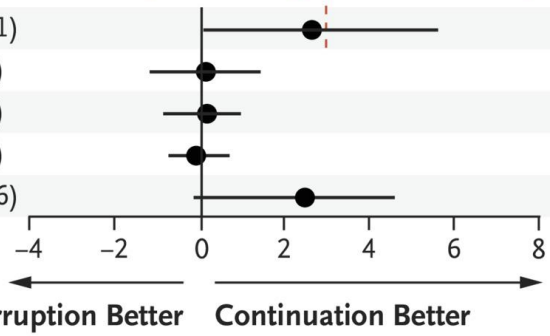


Table 2. Primary and Secondary End Points (Intention-to-Treat Population).

End Point	Beta-Blocker Interruption (N = 1846)	Beta-Blocker Continuation (N = 1852)	Risk Difference (95% CI)*	Hazard Ratio (95% CI)*	P Value†
Primary end point					
Composite of death, nonfatal myocardial infarction, nonfatal stroke, or hospitalization for cardiovascular reason — no./total no. (%)	432/1812 (23.8)	384/1821 (21.1)	2.8 (<0.1 to 5.5)	1.16 (1.01 to 1.33)	0.44
Secondary end points					
Composite of death, myocardial infarction, or stroke — no. (%)	132 (7.2)	126 (6.8)	0.4 (–1.3 to 2.0)	1.05 (0.82 to 1.34)	
Composite of death, myocardial infarction, stroke, or hospitalization for heart failure — no. (%)	155 (8.4)	141 (7.6)	0.8 (–1.0 to 2.5)	1.11 (0.88 to 1.39)	
Death — no. (%)	76 (4.1)	74 (4.0)			
Cardiovascular cause	28 (1.5)	21 (1.1)			
Noncardiovascular cause	44 (2.4)	48 (2.6)			
Undetermined cause	4 (0.2)	5 (0.3)			
Myocardial infarction — no. (%)	46 (2.5)	44 (2.4)			
Type 1: spontaneous	36 (2.0)	32 (1.7)			
Type 2: related to ischemic imbalance	1 (0.1)	0 (0.0)			
Type 4a: related to percutaneous coronary intervention	2 (0.1)	1 (0.1)			
Type 4b: related to stent thrombosis	8 (0.4)	11 (0.6)			
Stroke — no. (%)	18 (1.0)	19 (1.0)			
Ischemic	14 (0.8)	14 (0.8)			
Hemorrhagic	1 (0.1)	1 (0.1)			
Transient ischemic attack	3 (0.2)	4 (0.2)			
Hospitalization for cardiovascular reason — no. (%)	349 (18.9)	307 (16.6)			

Kidney Stones

Calcium oxalate/phosphate

Struvite (urease)

Uric acid

Cysteine

Calcium stones; causes

Low urine volume

Hypocitraturia

- High animal protein diet
- Hypokalaemia
- Acidosis

Hypercalciuria

- Idiopathic
- High salt intake

Hyperoxaluria

- Primary
- Fat malabsorption, Short gut
- Vitamin C or glycine excess
- Cystic kidney diseases

Calcium stones; treatment

Potassium citrate 1g (10mmol) tds

75% reduction in recurrent symptomatic stone

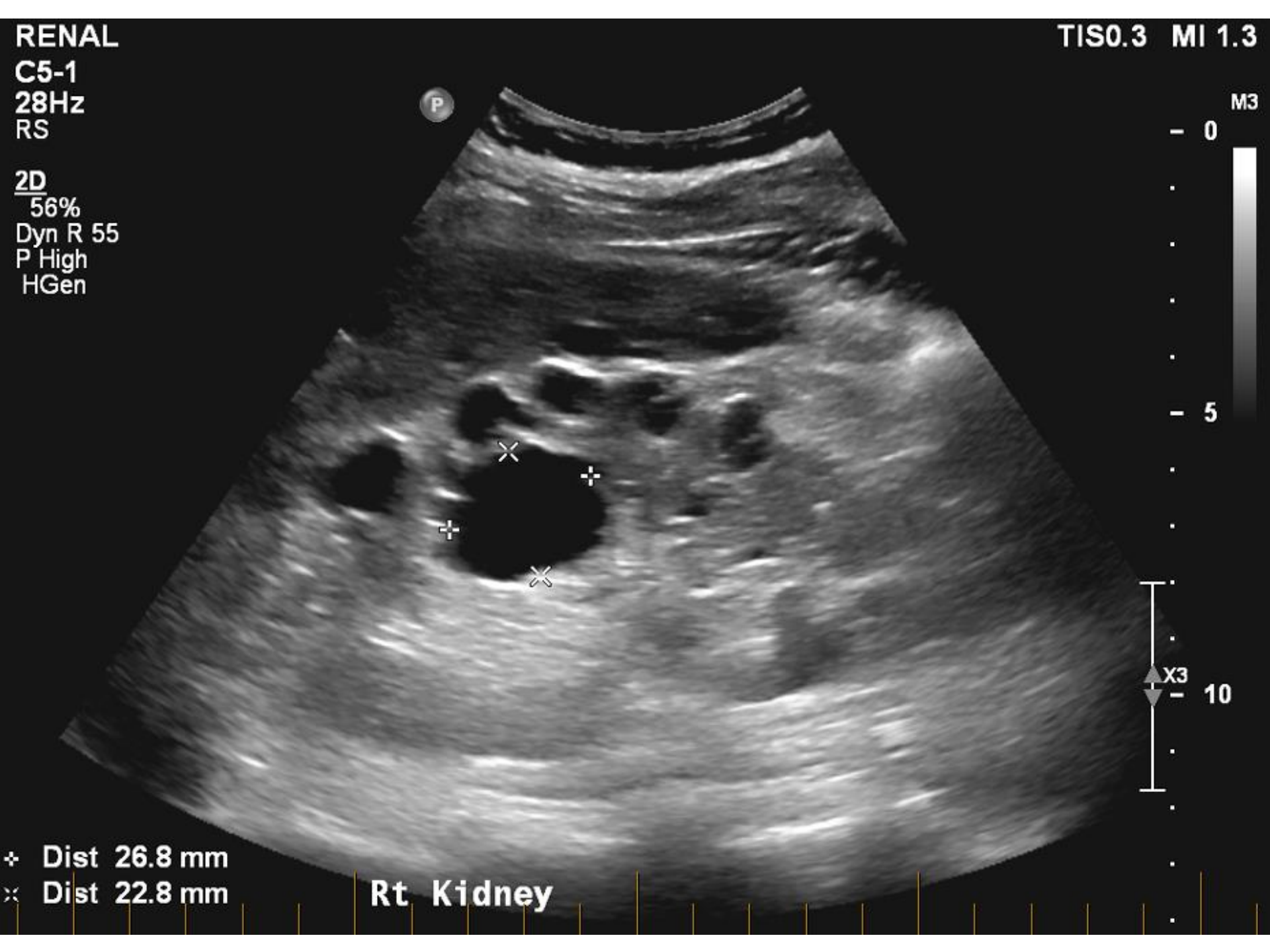
Maurício Carvalho et al, Effect of potassium citrate supplement on stone recurrence before or after lithotripsy: systematic review and meta-analysis. Urolithiasis 2017 Oct;45(5):449-455

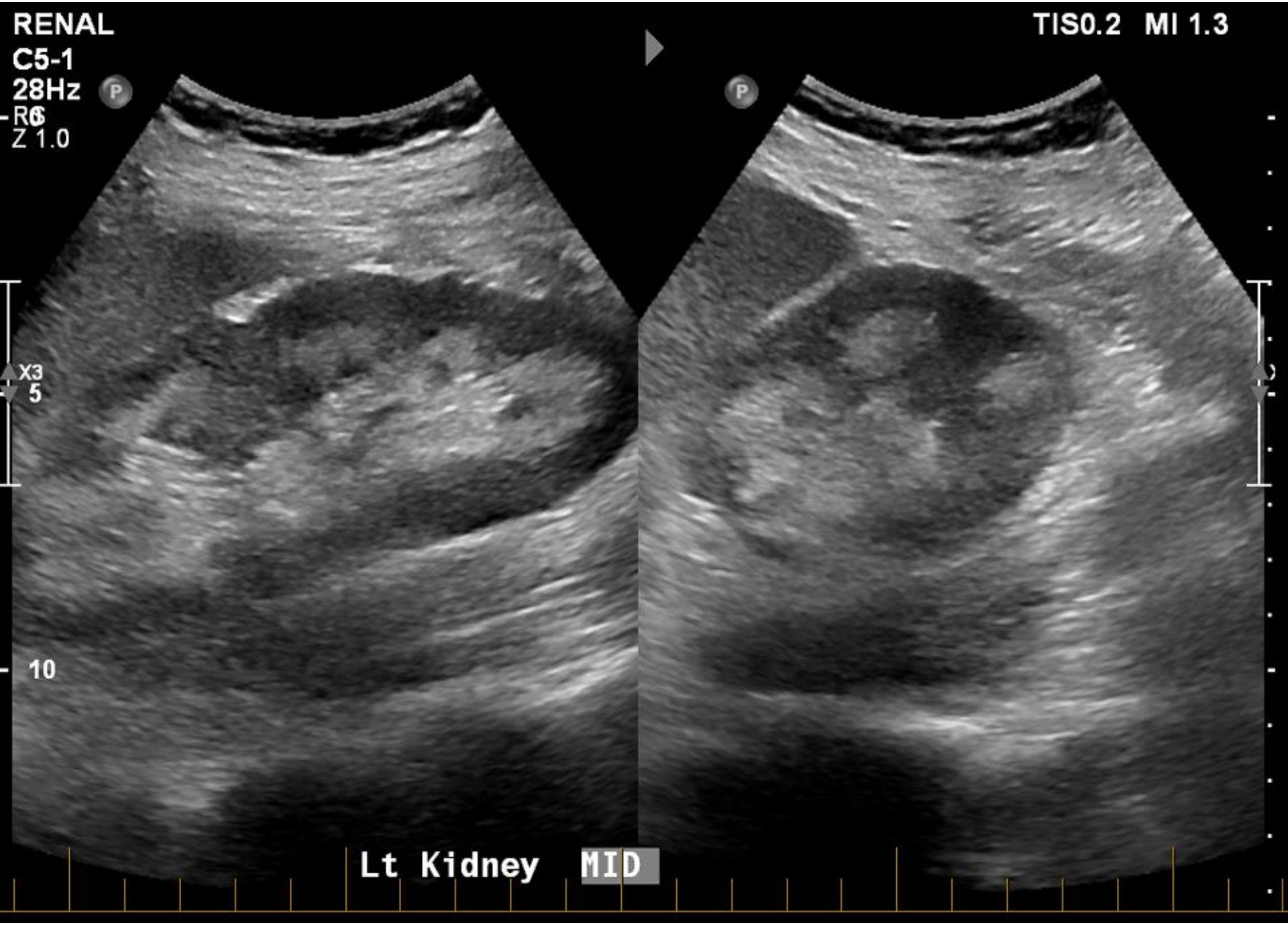
Adult bilateral cystic kidney diseases

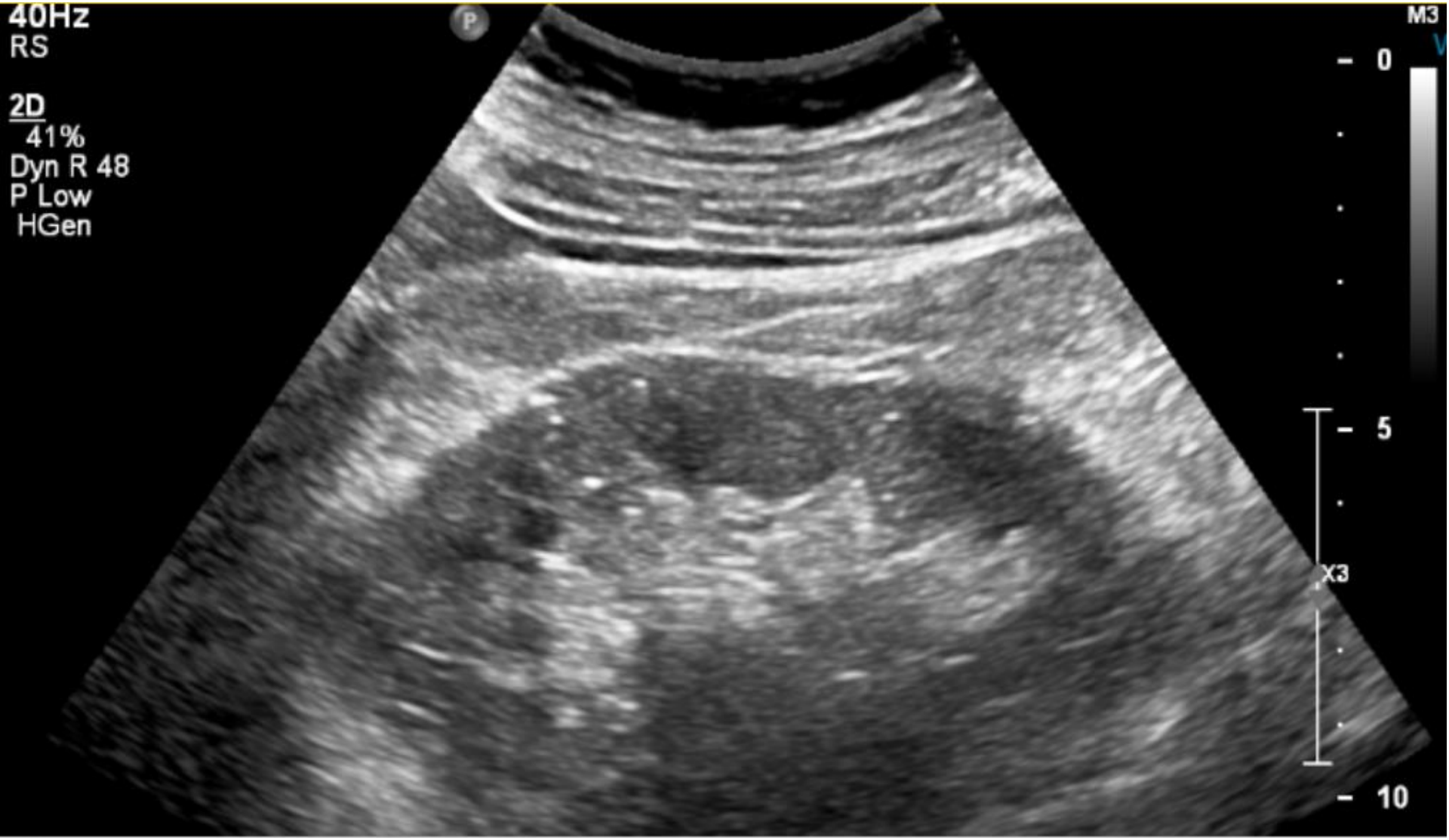
Autosomal Dominant PCKD

Medullary sponge kidney

Medullary cystic kidney disease


RENAL
C5-1
28Hz
RS
2D
56%
Dyn R 55
P High
HGen
TIS0.3 MI 1.3
M3
0
5
10
X3
Dist 26.8 mm
Dist 22.8 mm
Rt Kidney


RENAL
C5-1
28Hz
R6
Z 1.0
TIS0.2 MI 1.3
X3
5
10
Lt Kidney MID


40Hz
RS
2D
41%
Dyn R 48
P Low
HGen
M3
0
5
X3
10