Endovascular Renal Denervation across the Hypertension Spectrum

Michel Azizi,

Université Paris Cité,

CIC INSERM

Hypertension Unit,

Hopital Européen Georges Pompidou

Paris, France

Disclosures

Receipt of grants / research supports:

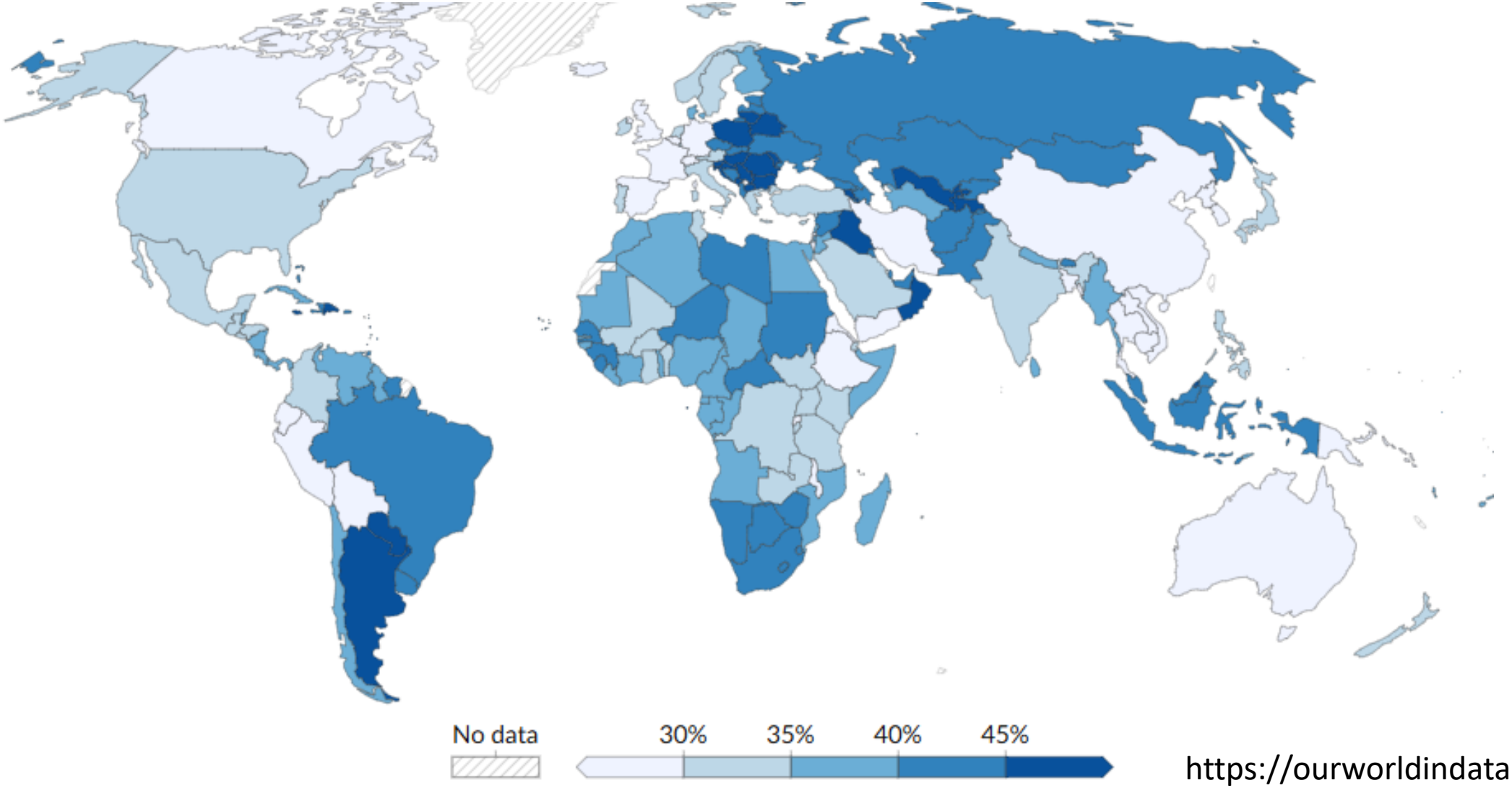
Recor, Novartis, Astra Zeneca, Sonivie

Receipt of honoraria or consultation fees:

Alnylam, Novartis, Medtronic, Astra Zeneca, Sonivie, Recor, Boehringer Ingelheim, Servier,

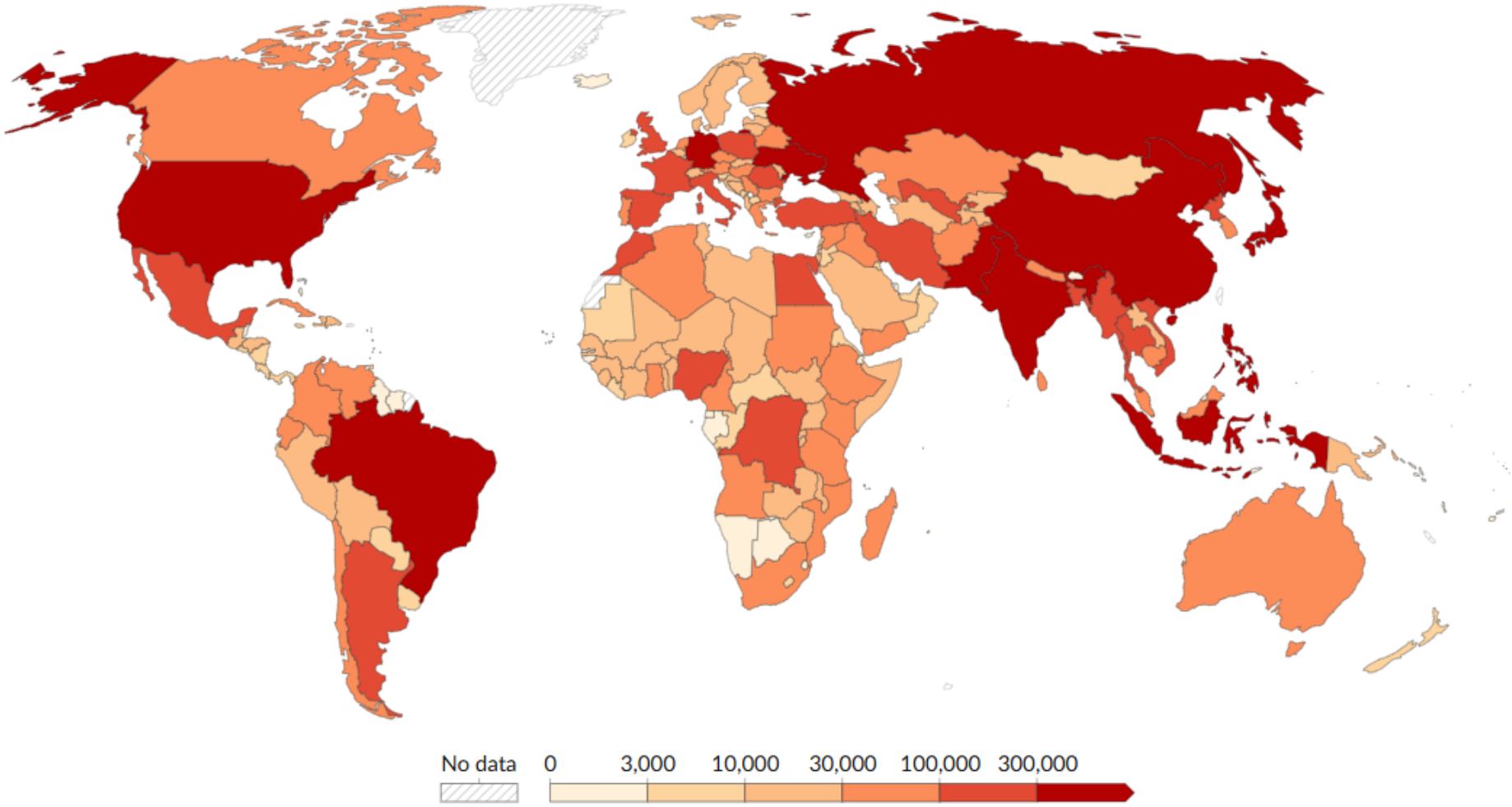
Prevalence rate of hypertension in adults aged 30-79, 2019

1.4 billion adults (33%) aged 30–79 years worldwide had hypertension in 2024

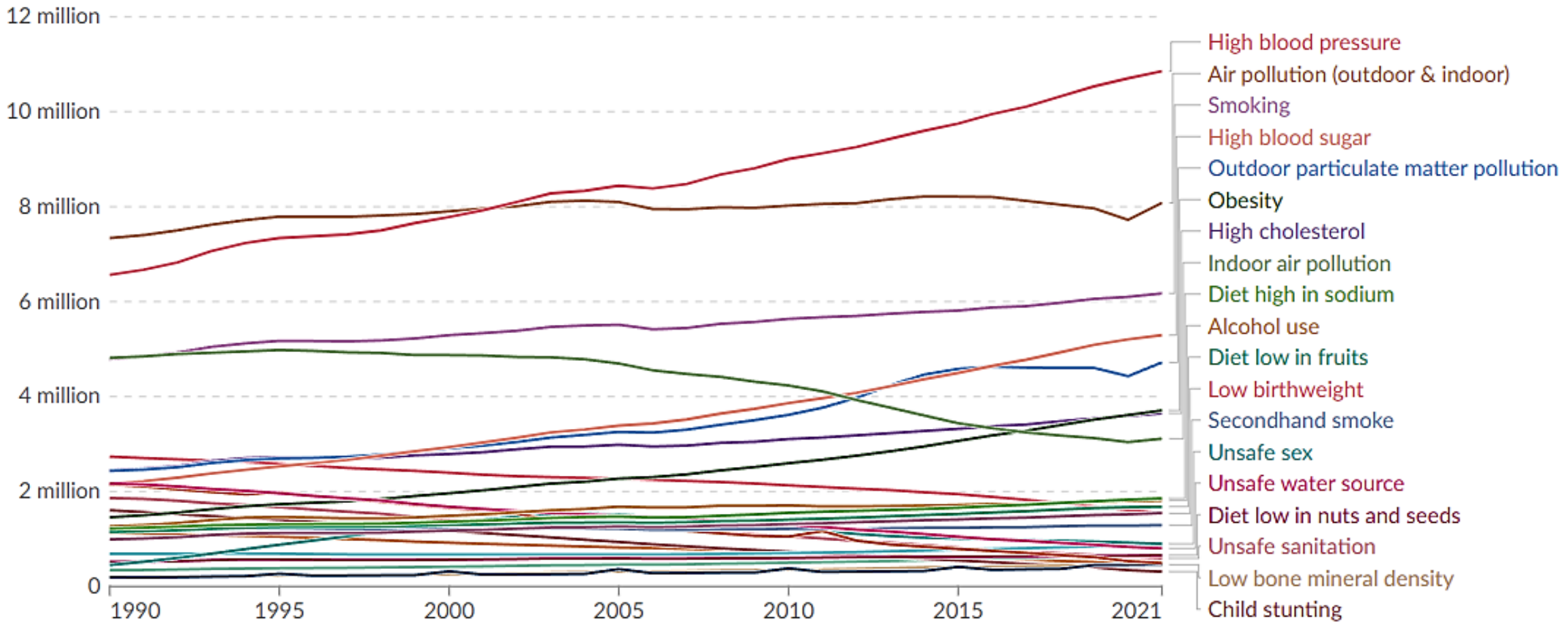


https://ourworldindata.org/

Number of deaths from cardiovascular diseases, 2021

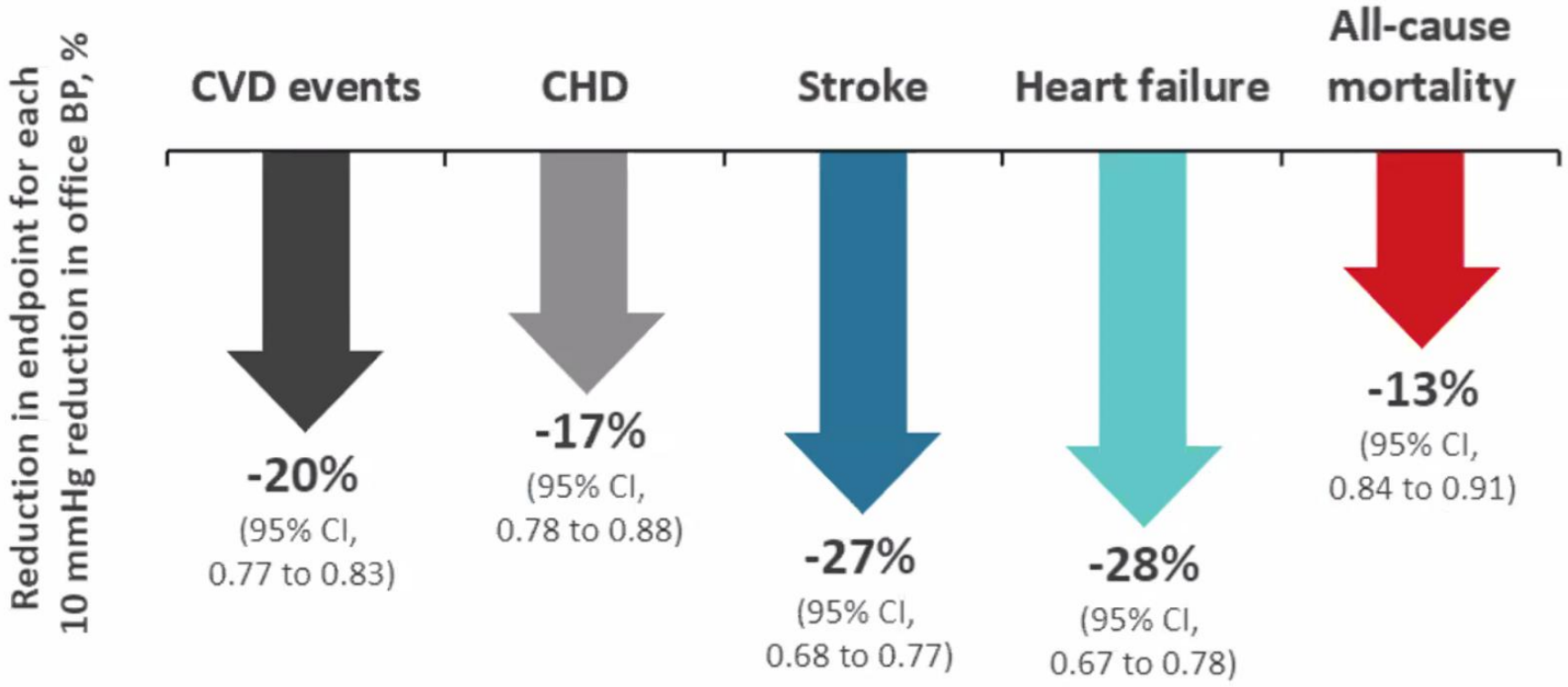


Deaths by risk factor, World, 1990 to 2021



https://ourworldindata.org/

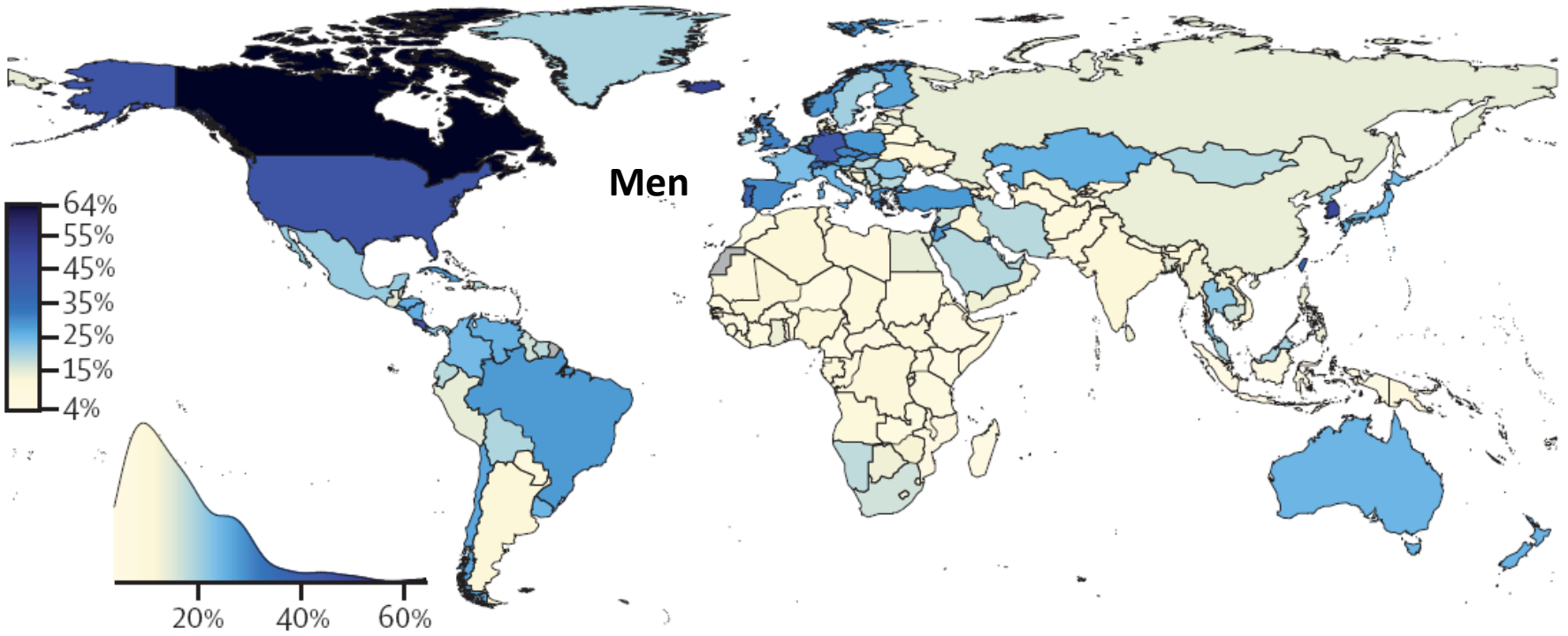
Benefits of SBP reduction

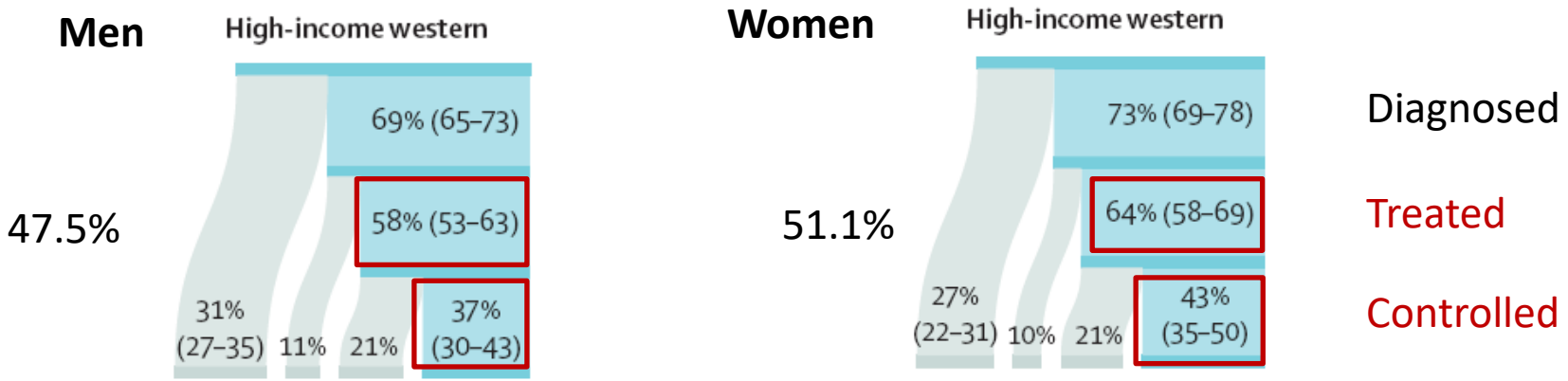


Each reduction in BP of 10 mmHg leads to vascular risk reductions

Systematic review and meta-analysis of large-scale BP-lowering trials, published between January 1, 1966, and July 7, 2015.
BP, blood pressure; CHD, coronary heart disease; CVD, cardiovascular disease.
Adapted from Ettehad D, et al. *Lancet* 2016;387:957-67.

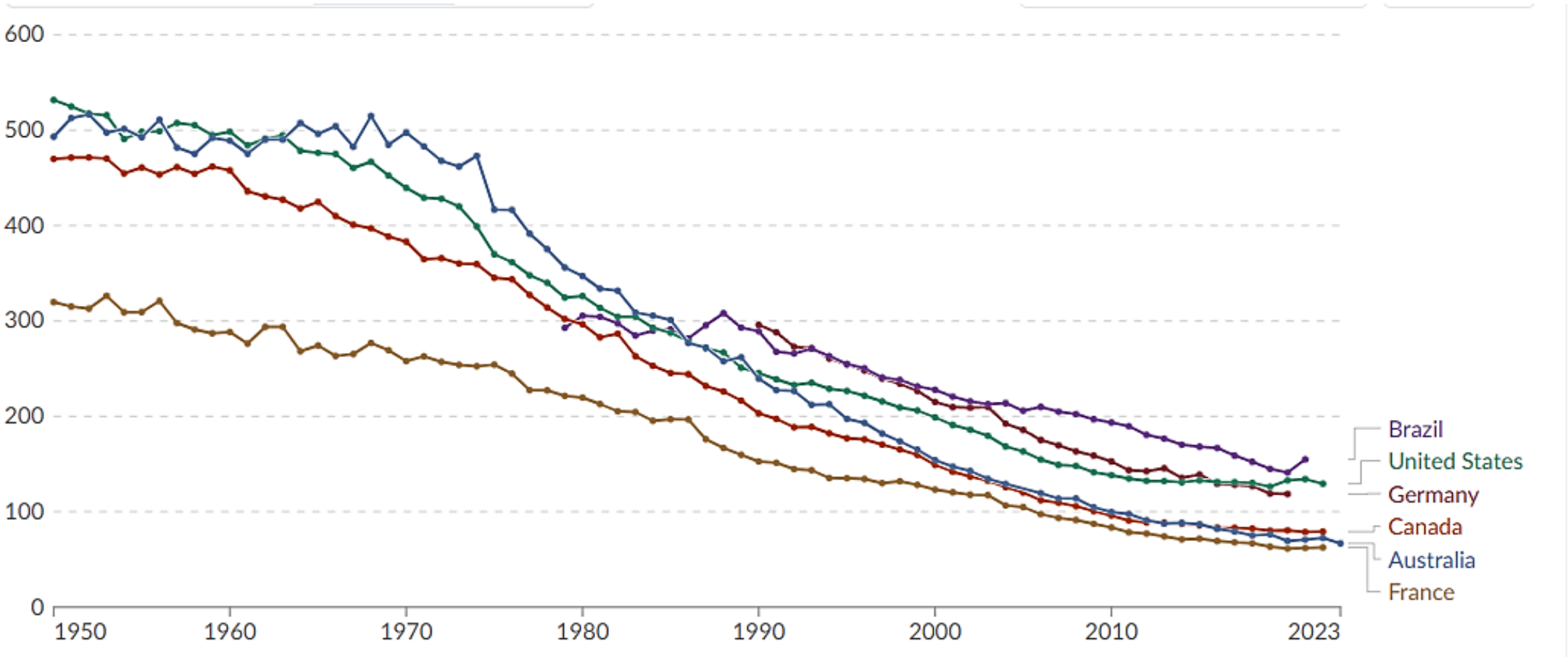
Worldwide control rate of HTN in 2019





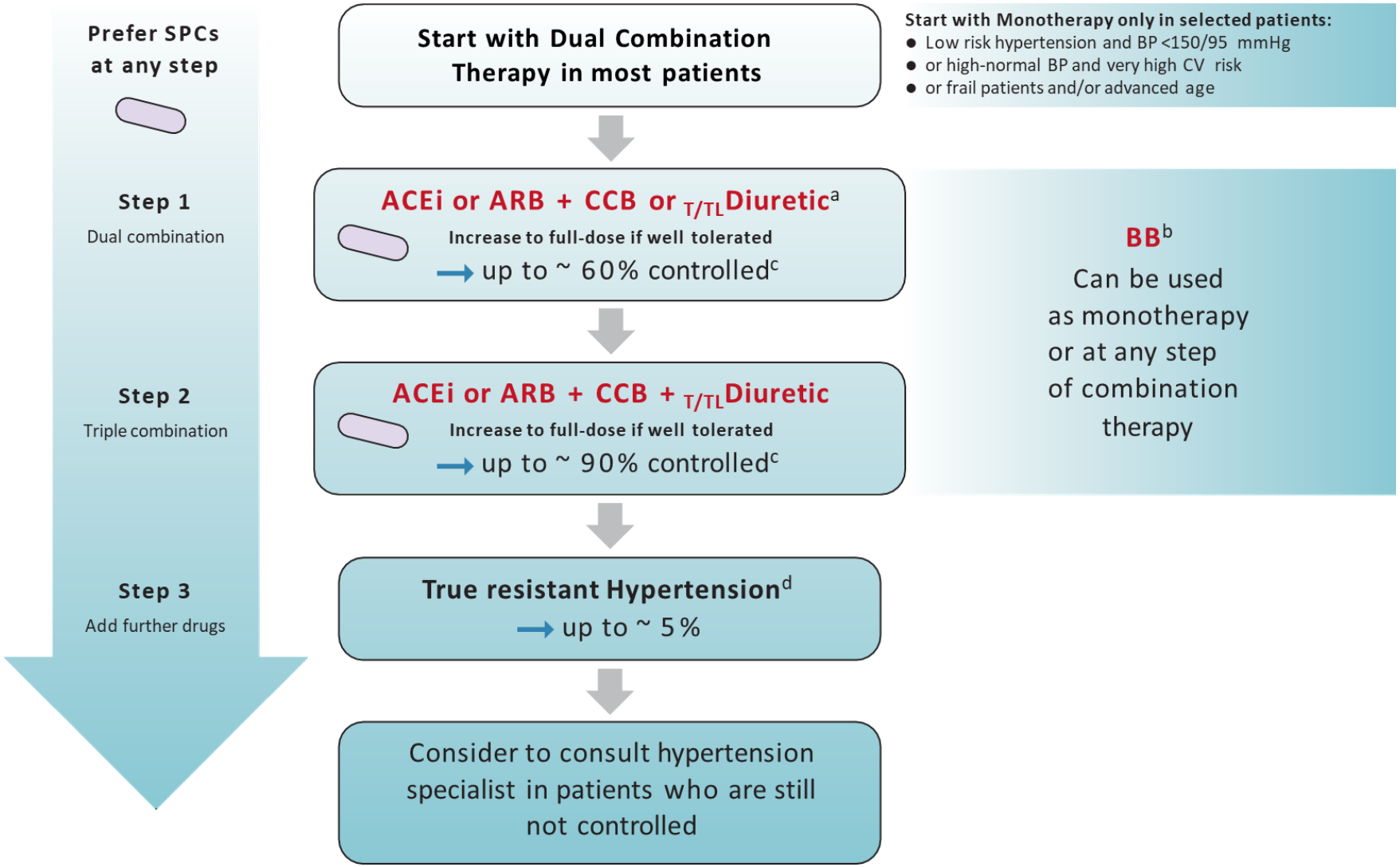
NCD-RisC. . Lancet. 2021;398:957

Death rate from cardiovascular diseases, 1950 to 2023



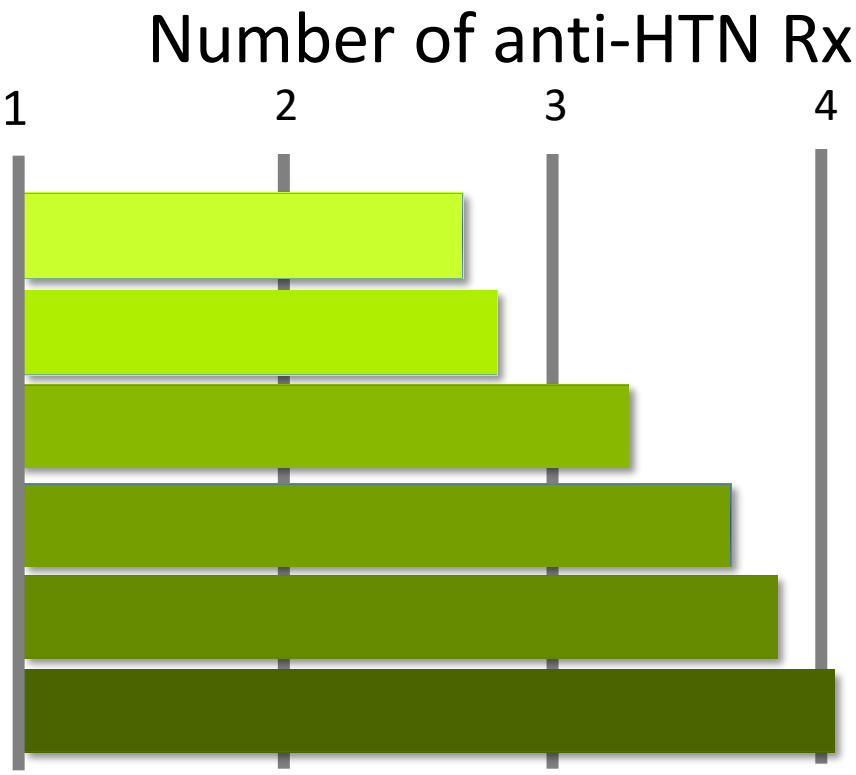
https://ourworldindata.org/

General BP-lowering strategy in patients with hypertension



Multiple antihypertensive drug therapy is necessary to control BP

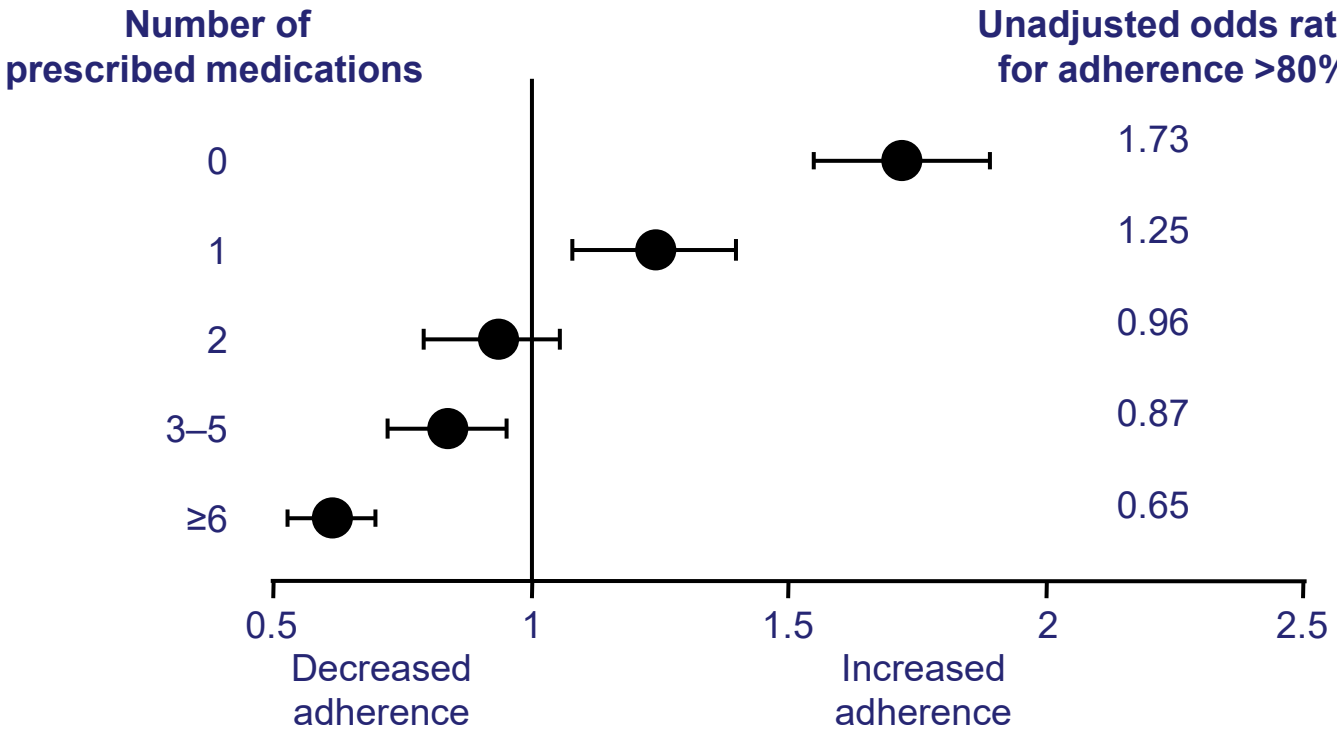
Trial	BP target, mmHg
UKPDS[1]	DBP <85
ABCD[2]	DBP <75
HOT[4]	DBP ≤80
MDRD[3]	MBP ≤92
AASK[5]	MBP ≤92
IDNT[6]	SBP/DBP ≤135/85



[1]UKPDS, BMJ 1998;317:703
[2]Estacio RO, Am J Cardiol 1998;82:9R
[3]Lazarus JM, Hypertension 1997;29:6
[4]Hansson L, Lancet 1998; 51:1755
[5]Kusek JW, Control Clin Trials1996;16:40S
[6]Lewis EJ, N Engl J Med 2001;345:851

The more you give the less they take !

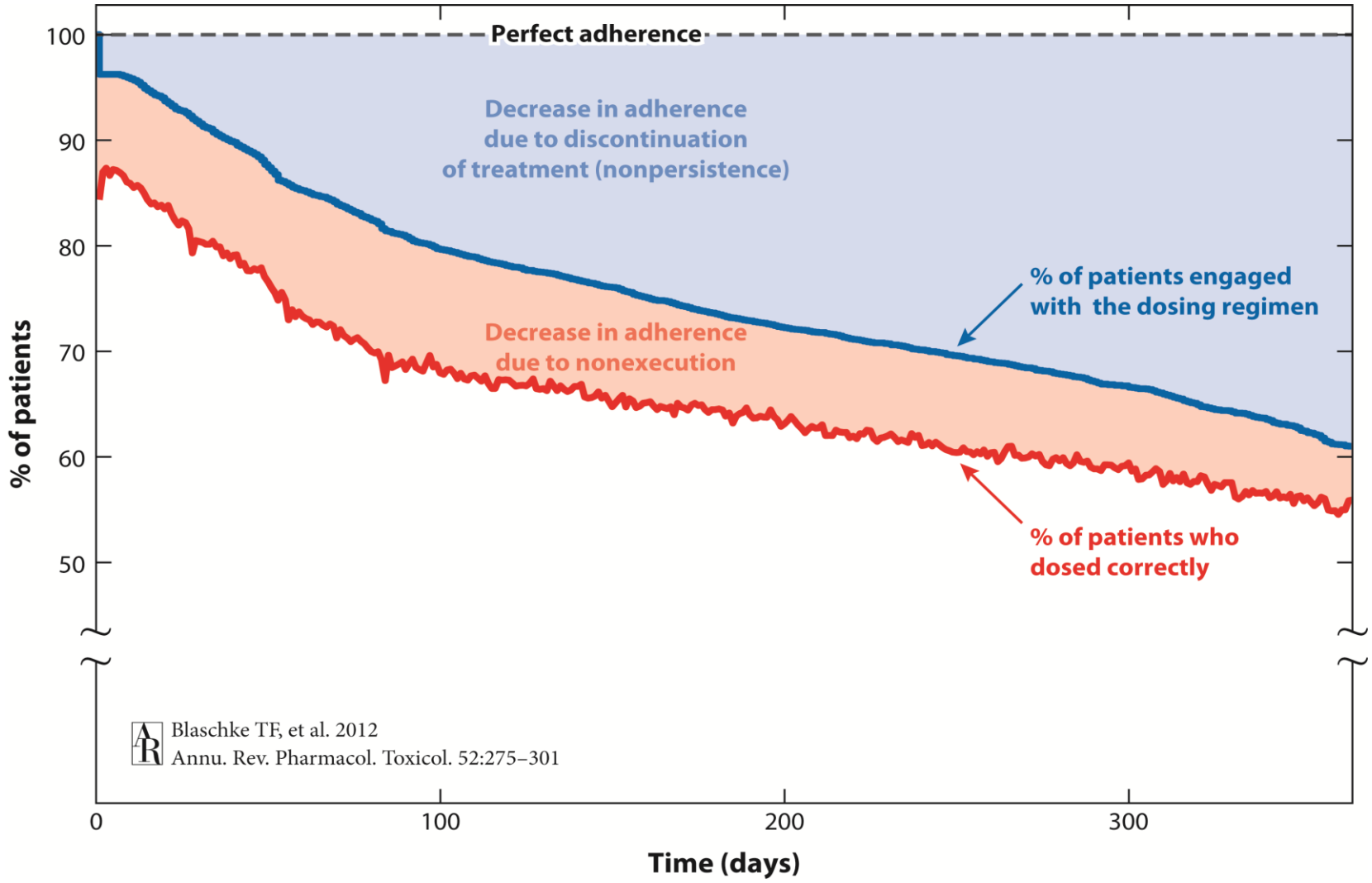
As the number of prescribed medications increases, the likelihood of adherence decreases



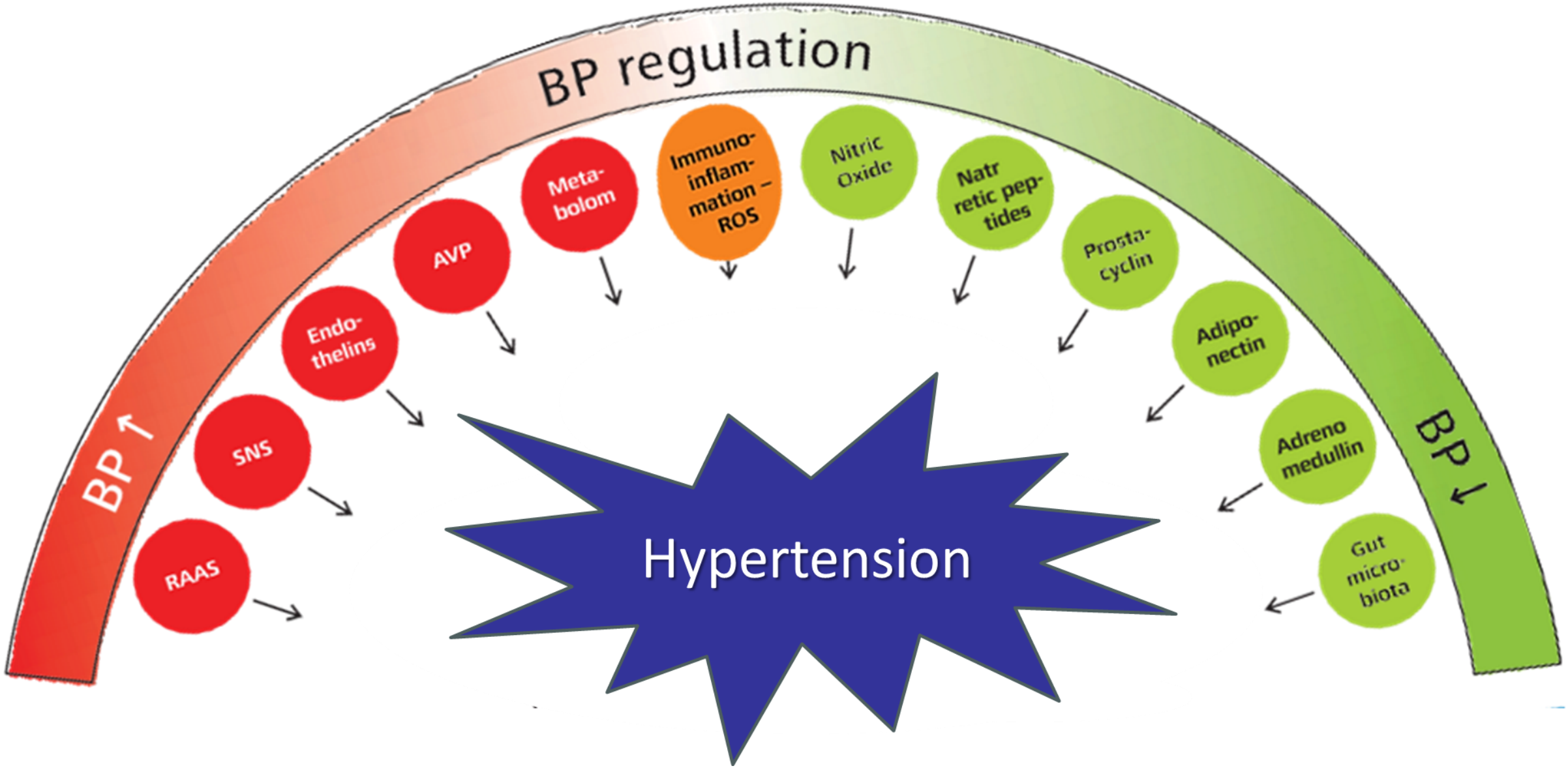
Retrospective study of 8,406 managed care patients with hypertension who added antihypertensive and/or lipid-lowering drugs to existing prescribed meds.

Chapman RH, et al. *Arch Intern Med* 2005;165:1147–52

Drug adherence in hypertension: Persistence is more problematic than daily compliance



Mechanisms involved in BP regulation and the pathophysiology of hypertension



Pathophysiology of resistant hypertension

1) RHTN is associated with higher aldosterone levels and intravascular expansion

Gaddam KK et al. Arch Intern Med. 2008;168:1159

2) Salt sensitivity in patients with RHTN

Calhoun DA. Annu. Rev. Med. 2013. 64:233

3) Sympathetic overdrive in conditions associated with RHTN (OSA, MS, CKD)

Mancia G , and Grassi G Circ Res. 2014;114:1804

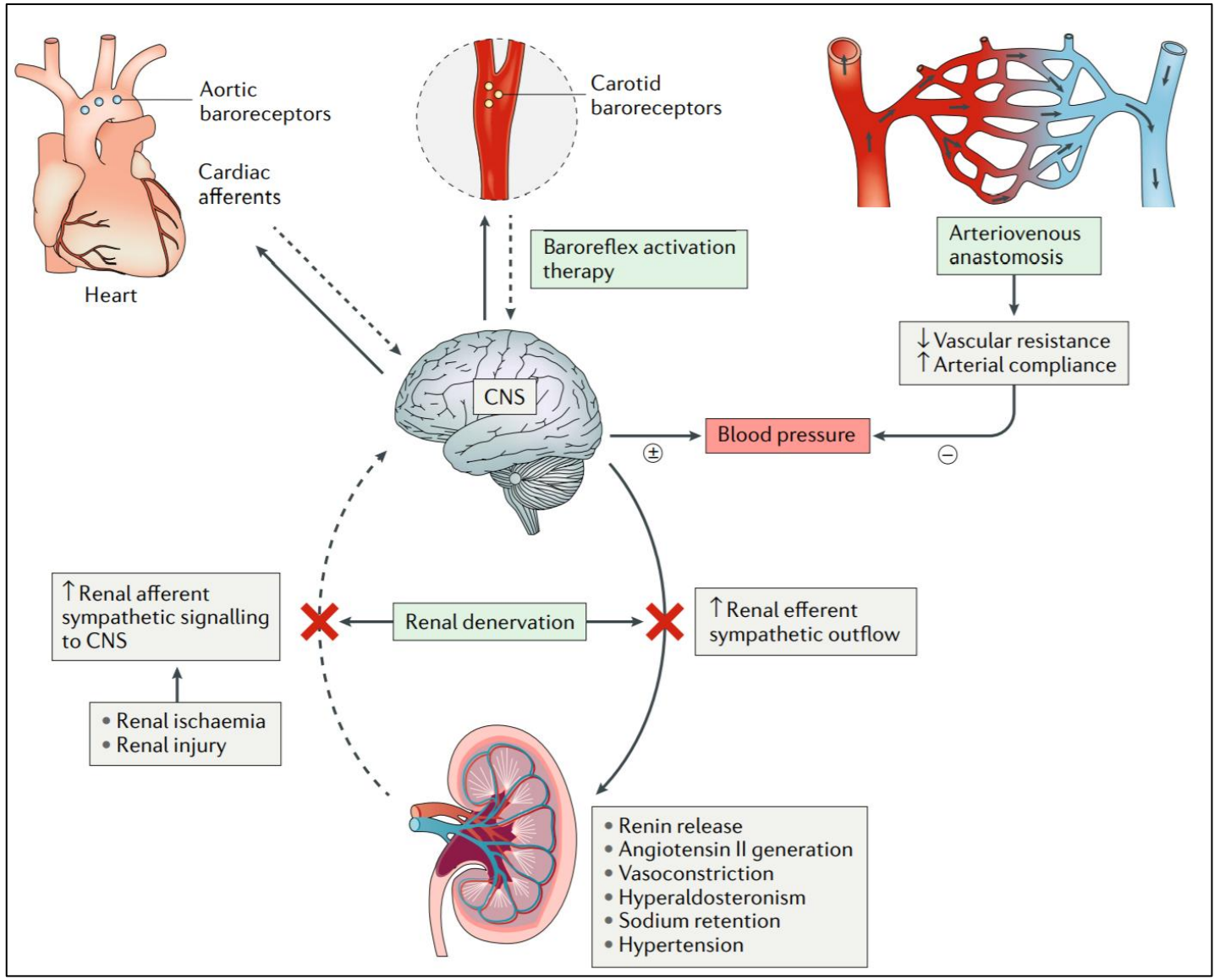
4) Primary central stimulation of AVP release

Mendes M et al. J Hypertens. 2016;34:2458

5) Activation of the endothelin system

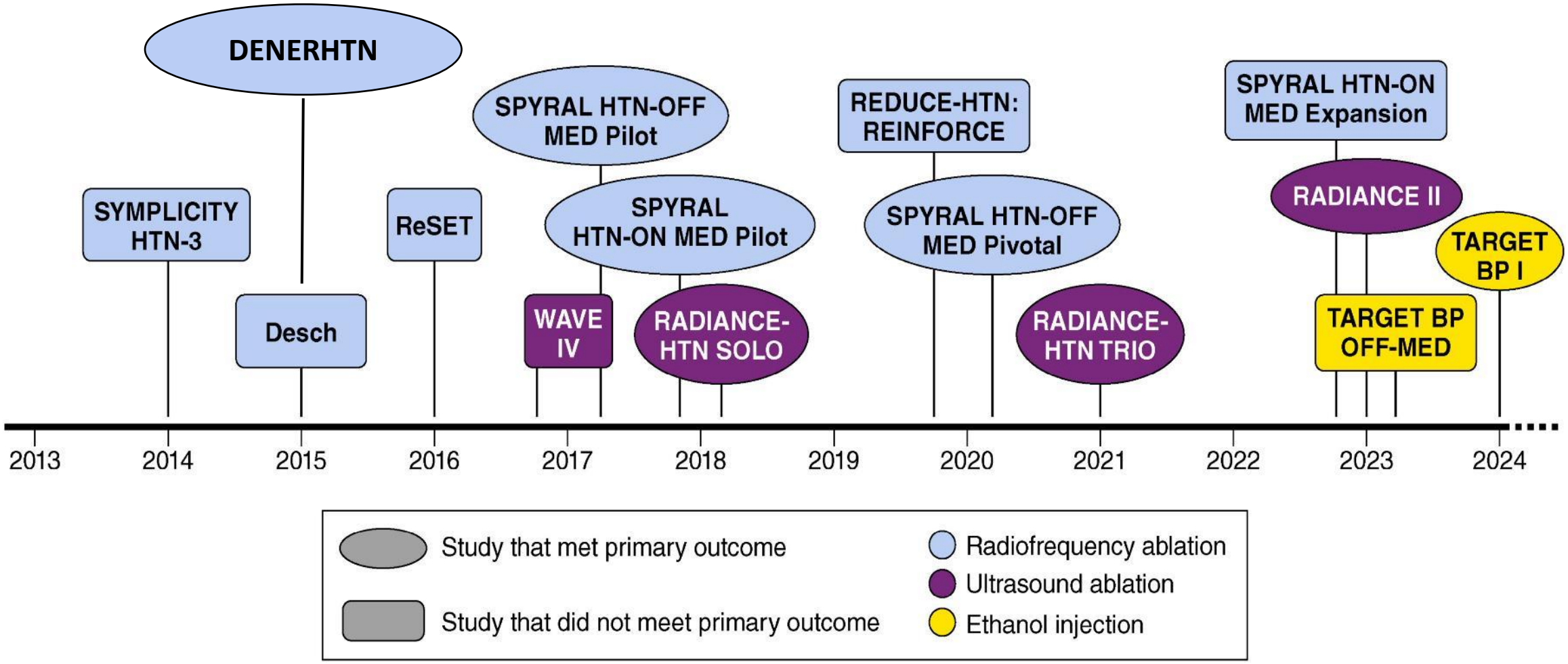
Weber MA. Lancet 2009; 374: 1423

Rationale for use of device therapy in hypertension



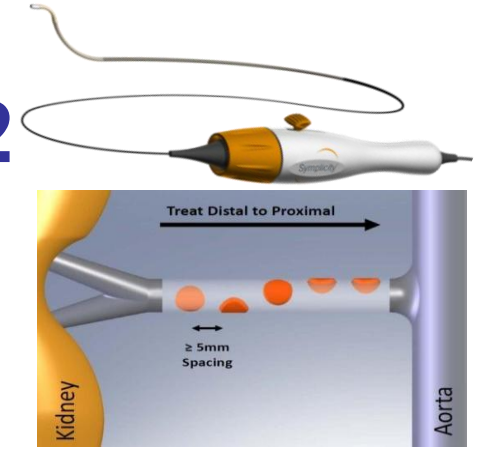
Wei FF Nature Reviews | Nephrology, 2018

Background: Milestones in RDN trials



Cluett JL. Hypertension. 2024;81: e135

BP decrease at 6 months in Symplicity HTN-2

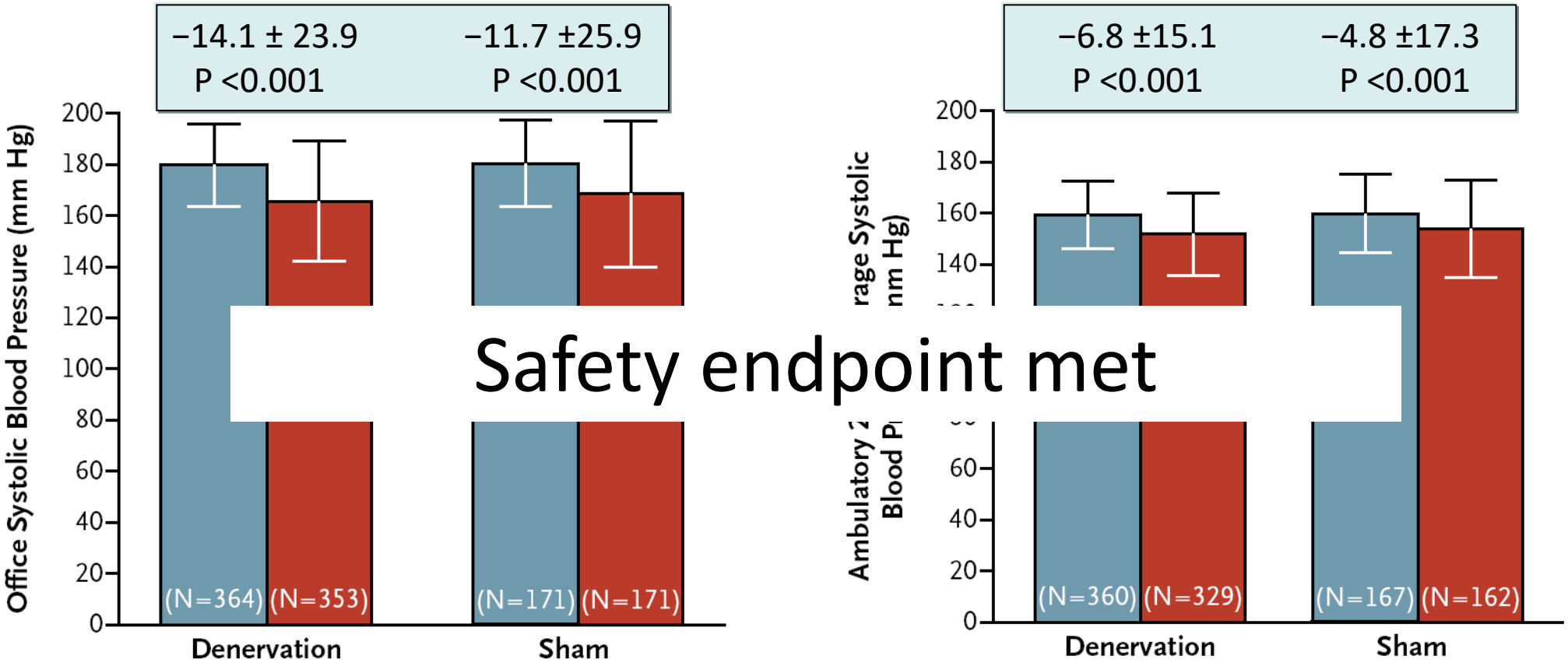


	RDN (n=52)	Control (n=54)	*p*
Office BP (mmHg)	**-32±23/-12±11 (n=49)**	**+1±21/0±10 (n=51)**	<0.0001
Self BP (mmHg)	-20±17/-12±11 (n=32)	+2±13/0±7 (n=40)	<0.0001
24h-ABPM (mmHg)	**-11±15/-7±11 (n=20)**	**-3±19/-1±12 (n=25)**	0.006/0.014
# Med Dose Decrease (%)	10 (20%)	3 (6%)	0.04
# Med Dose Increase (%)	4 (8%)	6(12%)	0.74

SBP < 140 mmHg: 39%

Symplicity HTN-2 Investigators. The Lancet. 2010.

Office and ambulatory SBP decrease at 6 months in Symplicity HTN-3



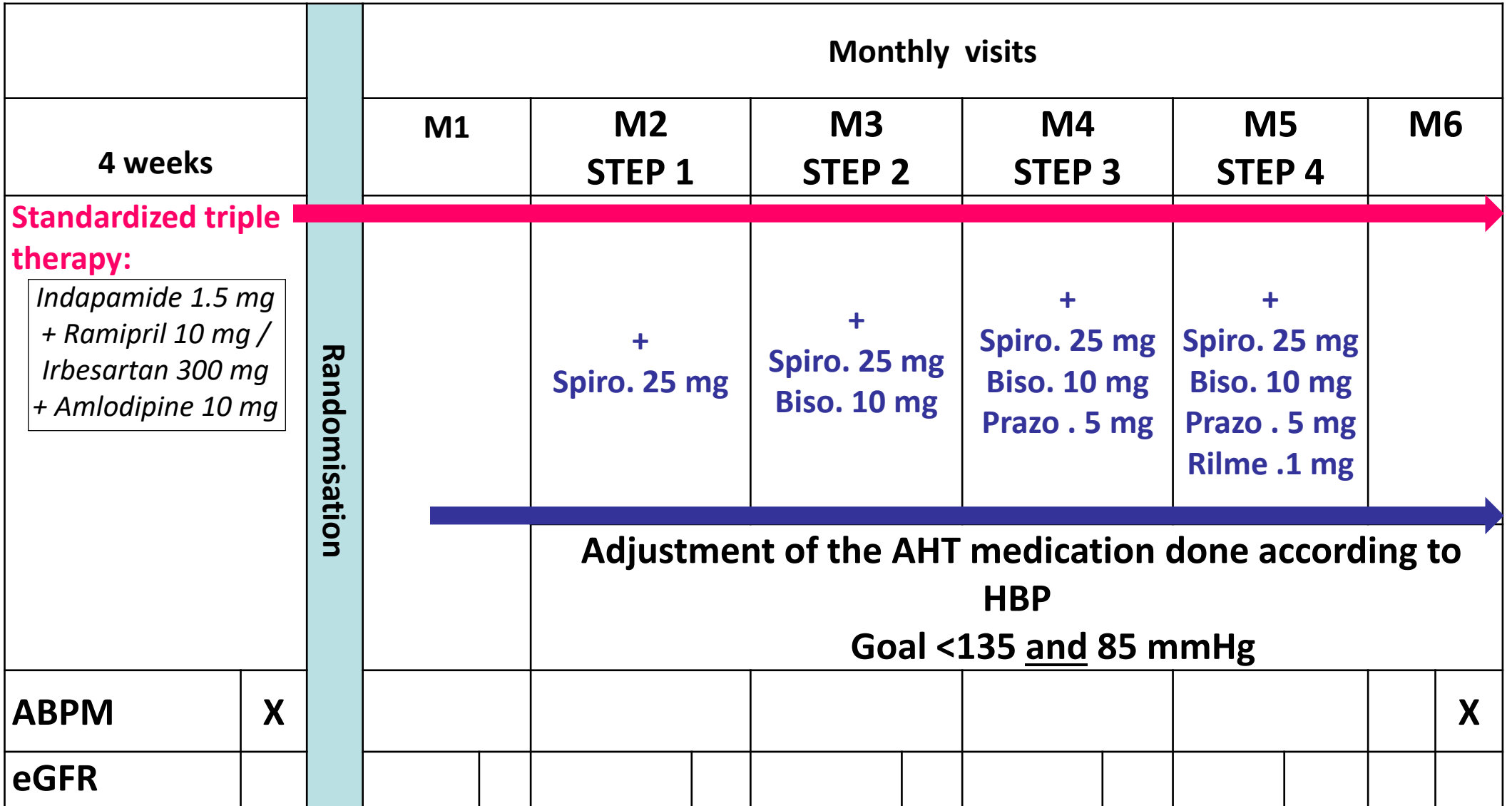
Safety endpoint met

Δ: −2.39 mm Hg (95%CI: −6.89 to 2.12; P =0.26)
Superiority margin: 5 mmHg

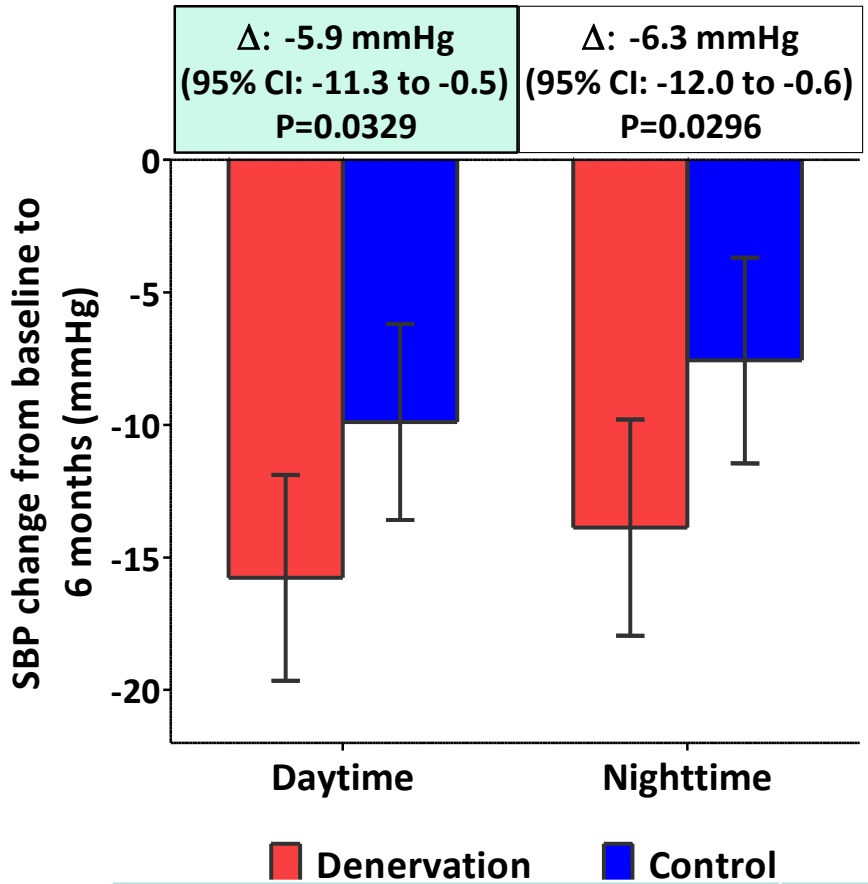
Δ: −1.96 mm Hg (95% CI, −4.97 to 1.06); P=0.98)
Superiority margin: 2 mmHg

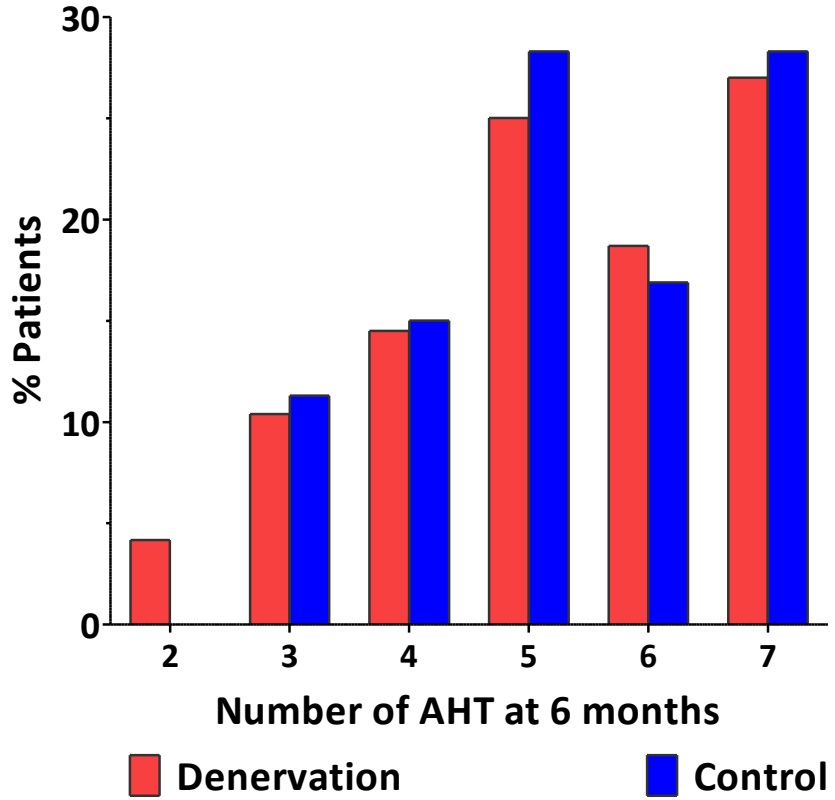
Bhatt DL et al., NEJM March 29, 2014

The French DENERHTN trial: Standardized optimal antihypertensive treatment



Baseline-adjusted changes (95%CI) in daytime and nighttime ambulatory BP from randomisation to 6 months

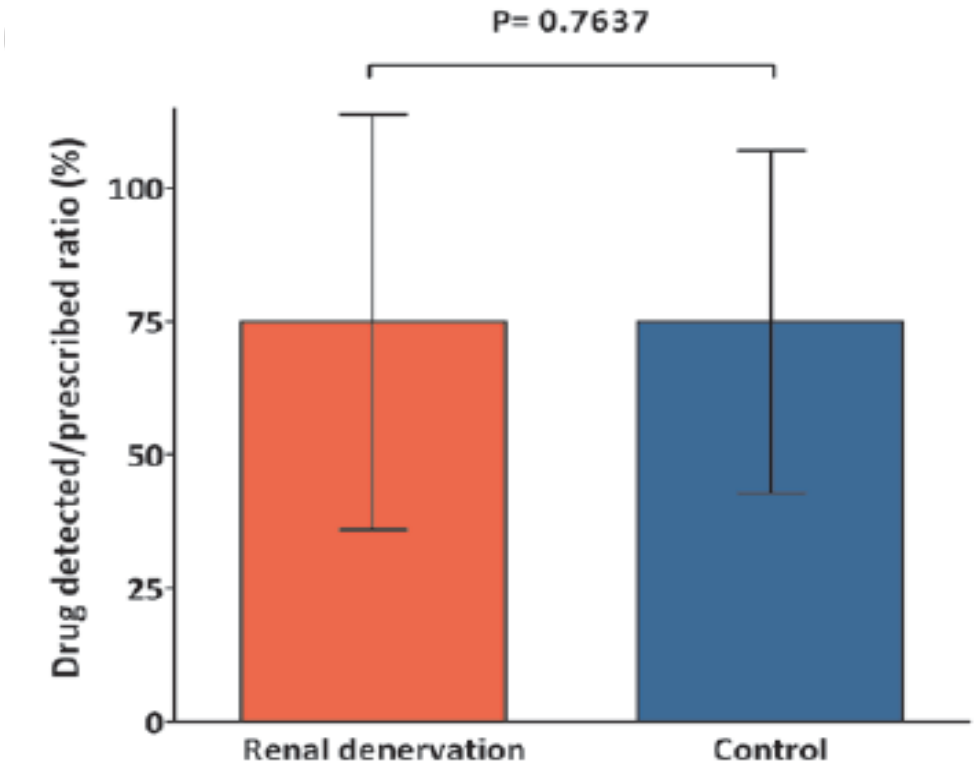


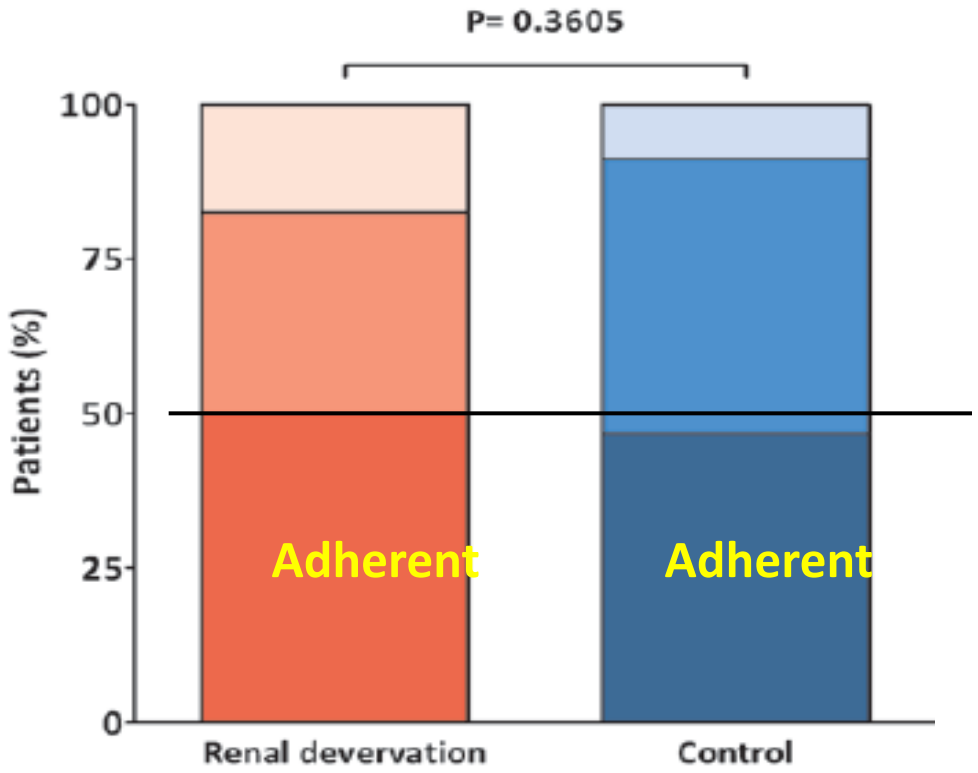


	Renal denervation	Control	P
% patients with 24 h BP < 130/80 mmHg	39.6	18.9	0.0216

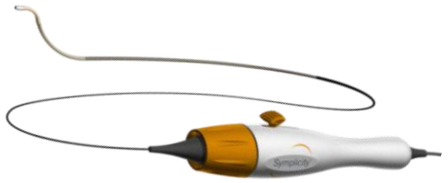
Azizi M Lancet 2015; 385: 1957–65

Poor adherence to AHT in the DENERHTN trial at 6 months



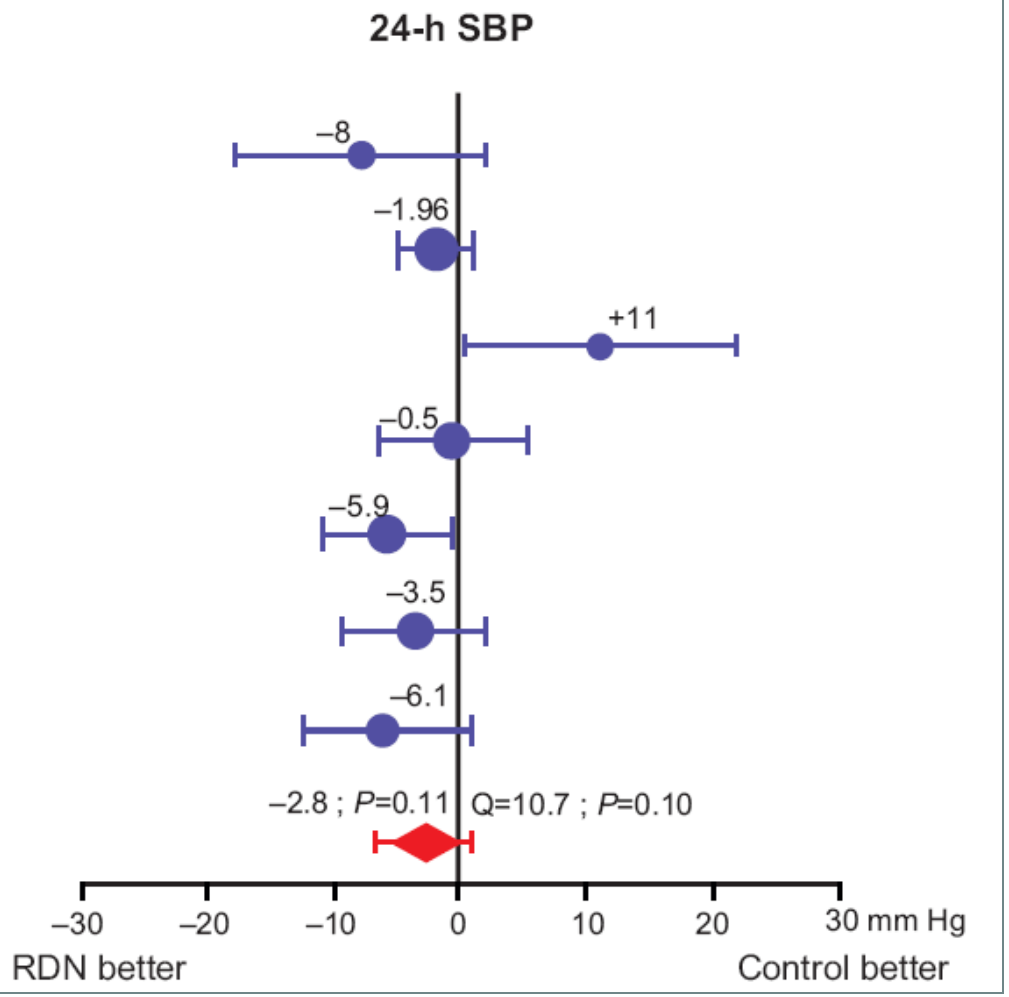


Azizi M et al. Circulation. 2016;134:847



Metaanalysis of 6-month response of 24 h SBP to unipolar RF-RDN

	Control		RDN	
	N°	Δ (SD)	N°	Δ (SD)
SYMPLICITY-2	25	–3 (19)	20	–11 (15)
SYMPLICITY-3	162	–4.8 (17)	329	–6.8 (15)
OSLO	10	–21 (13)	9	–10 (11)
PRAGUE	54	–8.1 (17)	52	–8.6 (12)
DENER	53	–9.5 (13)	48	–15.4 (13)
SYMPLICITY-F	35	–3.5 (10)	32	–7.0 (11)
SYMPLICITY-J	19	–1.4 (10.2)	22	–7.5 (12)
ALL	358	–6.7 (–11.2, -2.2)	512	–9.2 (–12.2, –6.2)
		P=0.011		*P*<0.001



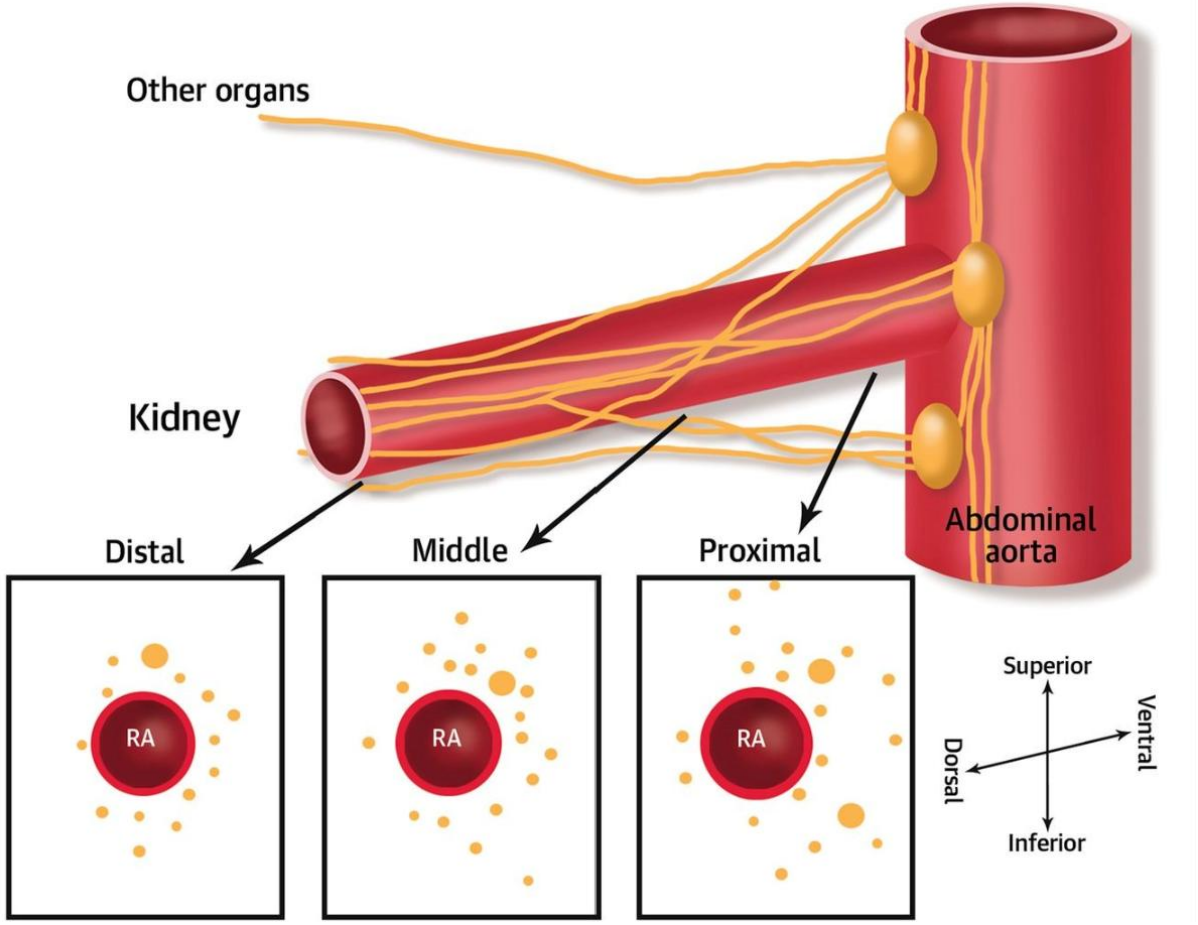
Fald Elmula FE. Blood Press. 2015 Oct;24(5):263-74.

The Path Forward for RDN: Consensus Statement on Trial Design

- Homogenous HTN patient populations
- BP reduction targets (6mmHg ABP/10mmHg OBP)
- Primary Endpoint ABPM
- Need for Sham
- Address medication adherence (Off Drug vs. On Drug)
- Consistent Denervation Treatment

[1]Mahfoud F, Bohm M, Azizi M et al. Proceedings from the 2nd European Clinical Consensus Conference for device-based therapies for hypertension: state of the art and considerations for the future. European Heart Journal. 2017;0:1–11

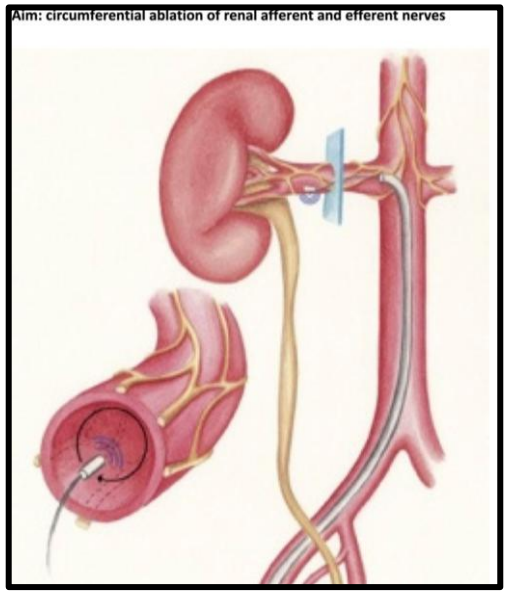
Distribution and Density of Renal Sympathetic Nerves



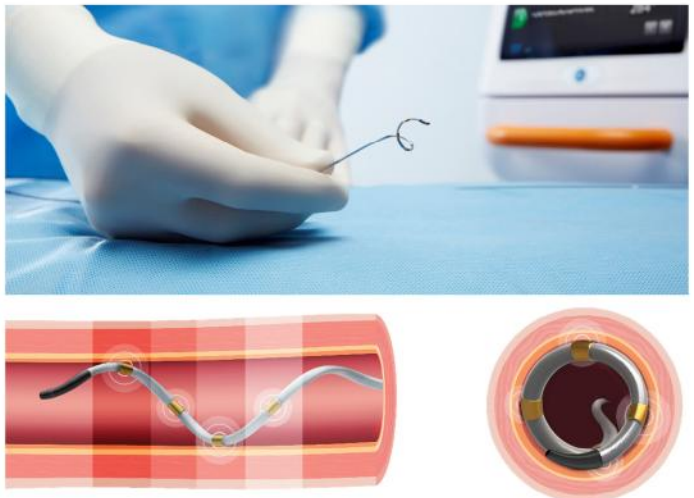
The relationship between the anatomic location of sympathetic nerves within the renal arteries (proximal, middle, or distal and ventral or dorsal) may influence the amount of energy required to achieve catheter-based renal denervation.

Sakakura K. J Am Coll Cardiol 2014;64:635

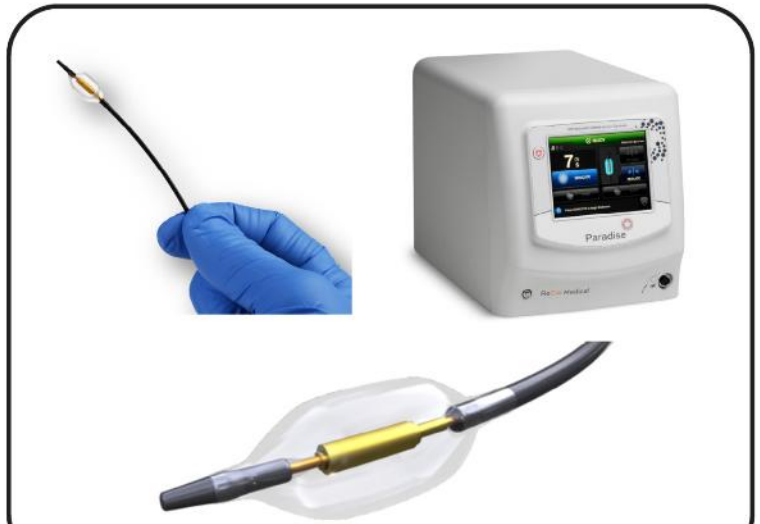
Renal denervation systems



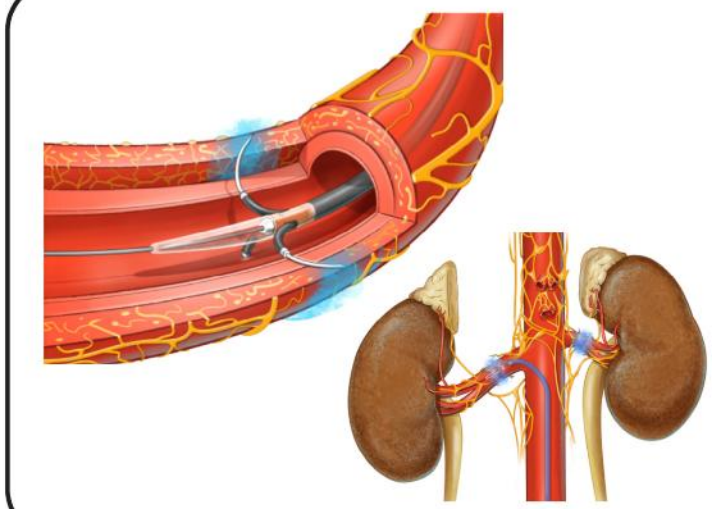
Medtronic Spyral® System



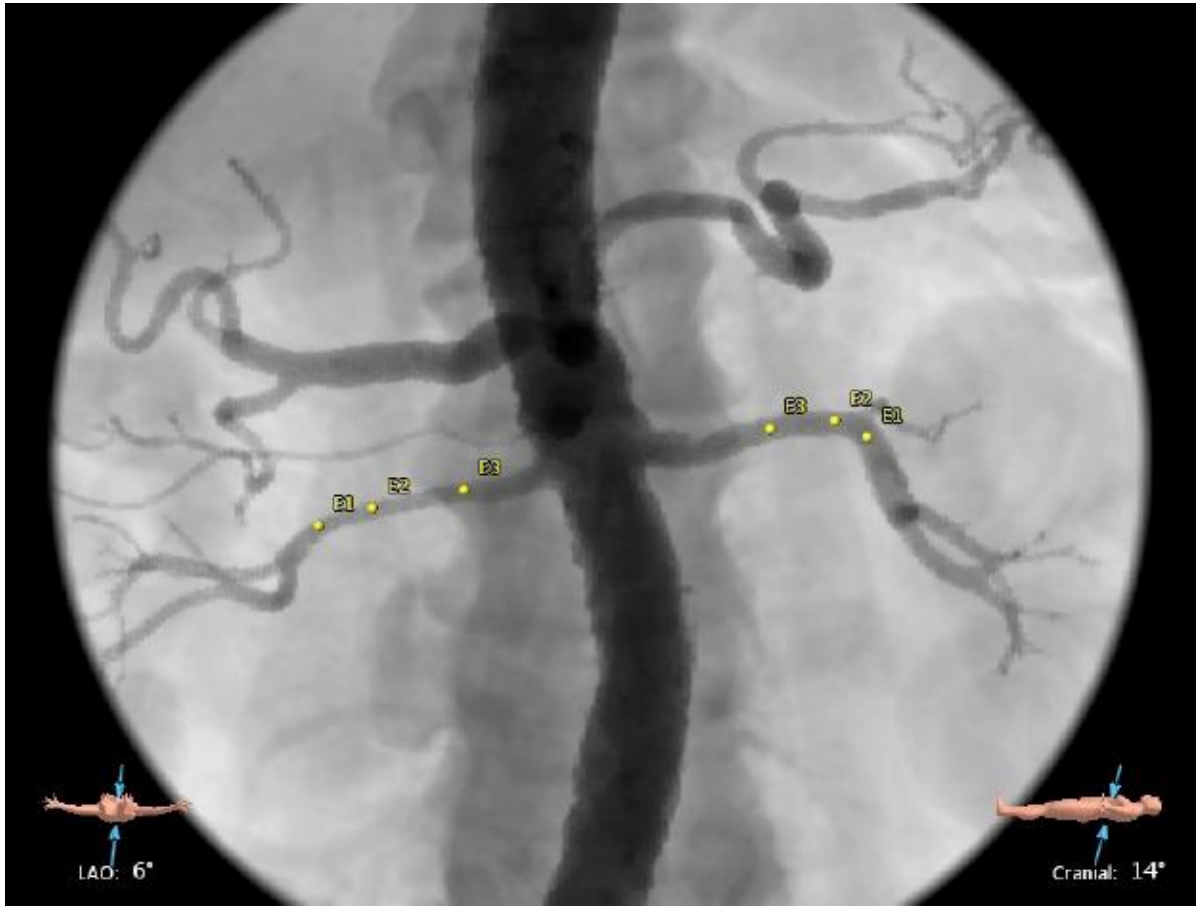
ReCor Paradise® System

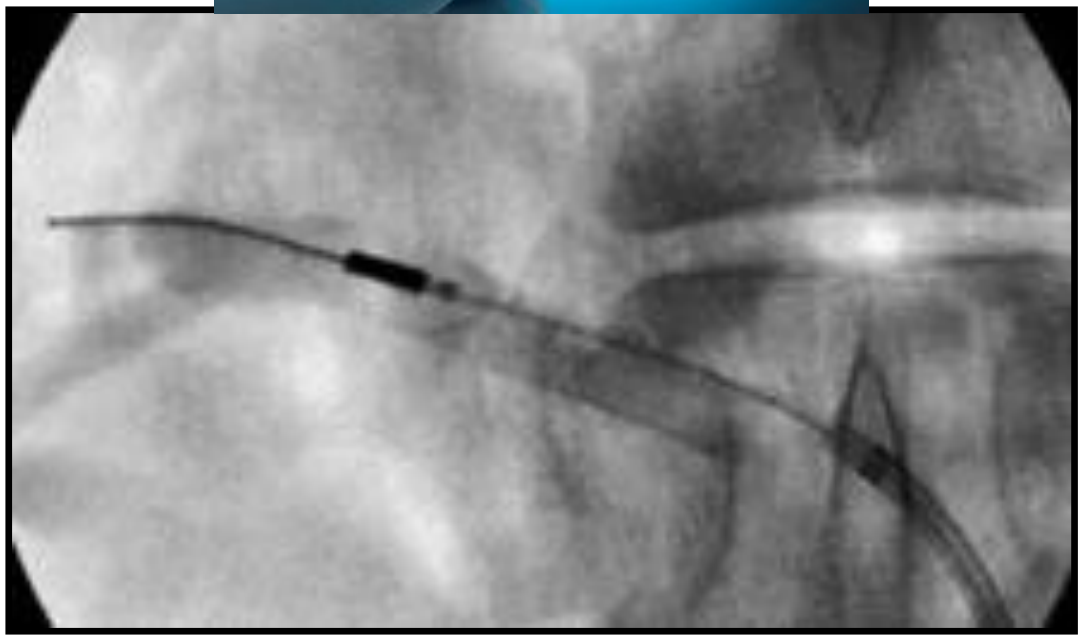


Ablative Solutions Peregrine® System



Procedure with the US RDN catheter





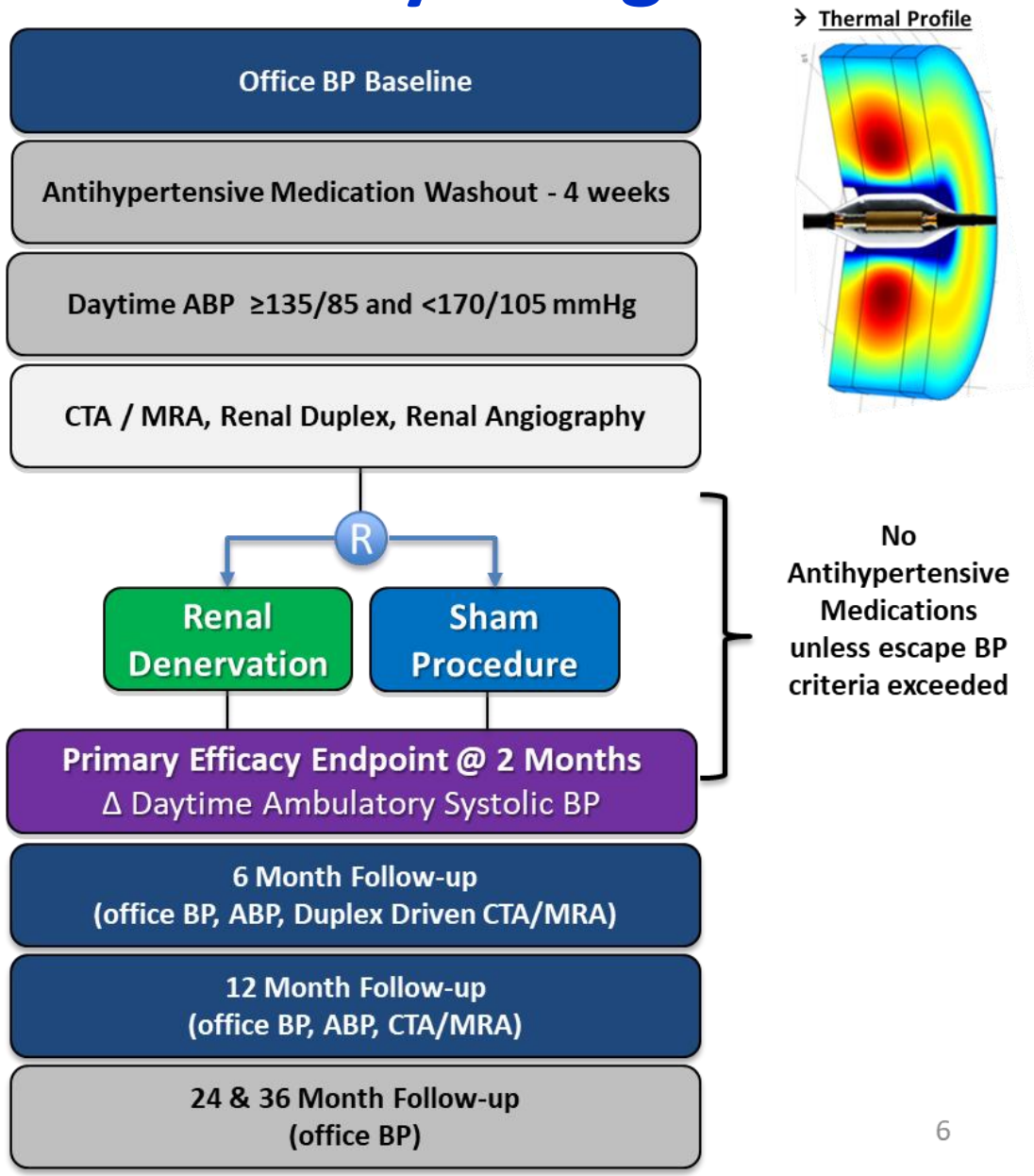
OFF-MED Studies

RADIANCE-HTN SOLO - Study Design

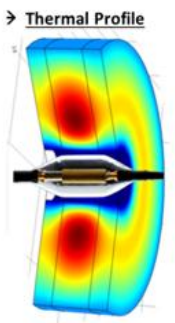
Multicenter, Blinded, Sham-Controlled trial
Powered to Demonstrate BP Lowering Effectiveness at 2M

Key Entry Criteria:

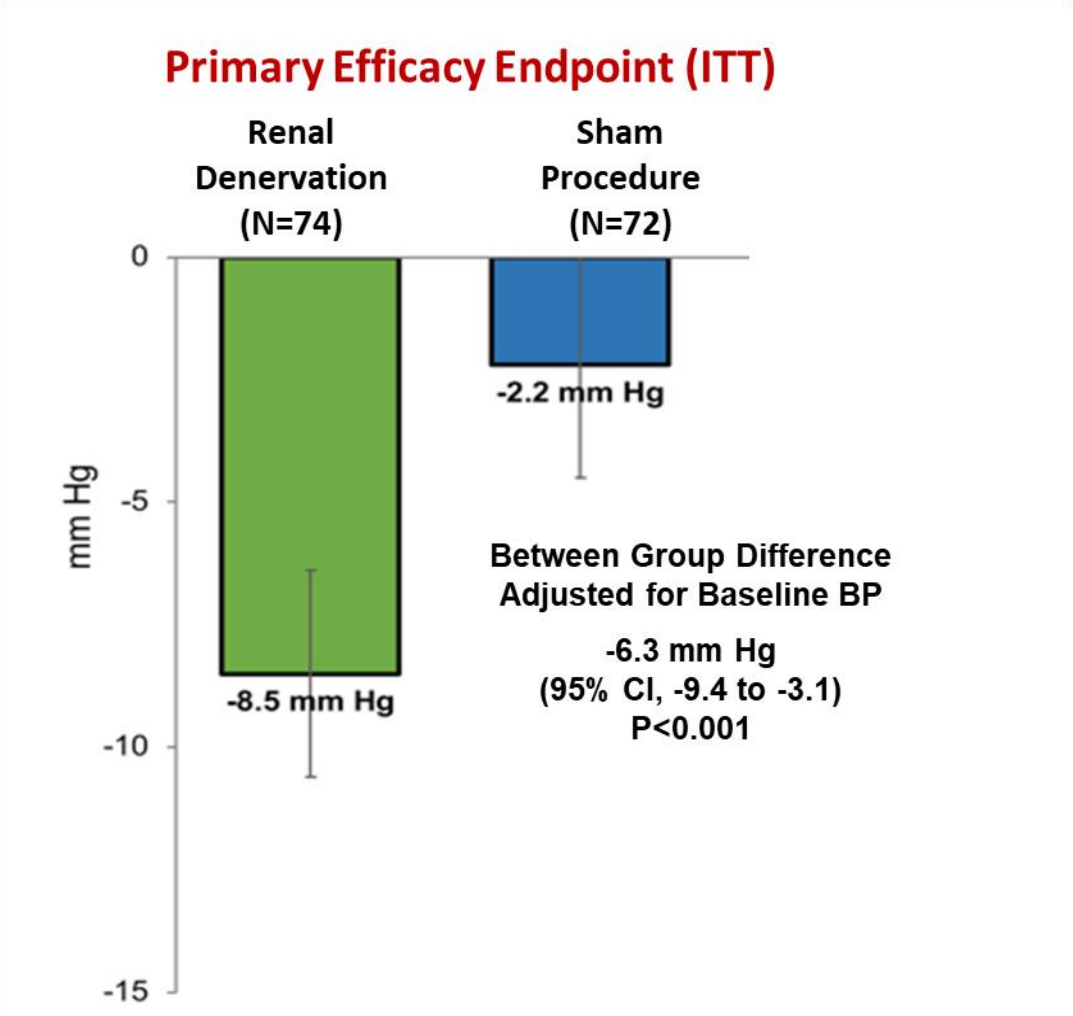
- Hypertension controlled on 1-2 anti-HTN meds or uncontrolled on 0-2 meds
- Off-medication daytime ABP ≥135/85 and <170/105 mmHg
- Age 18-75 years
- No prior cardiovascular or cerebrovascular events
- No Type I or uncontrolled Type II diabetes
- eGFR ≥40mL/min/m^2
- Eligible renal artery anatomy (bilateral diameter 4-8mm, length ≥25mm, and no stenosis ≥30%)

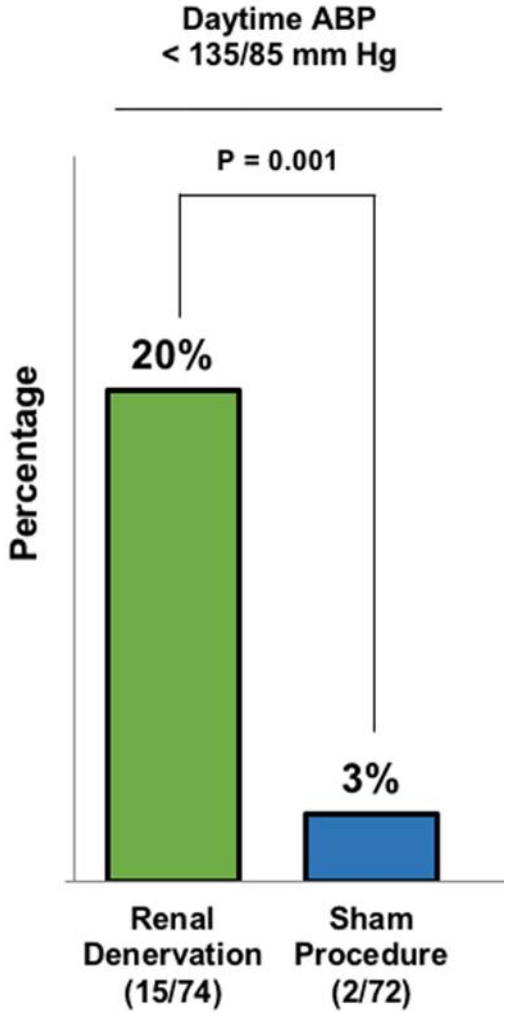


Azizi et al. *Lancet*. 2018; 391: 2335–2345



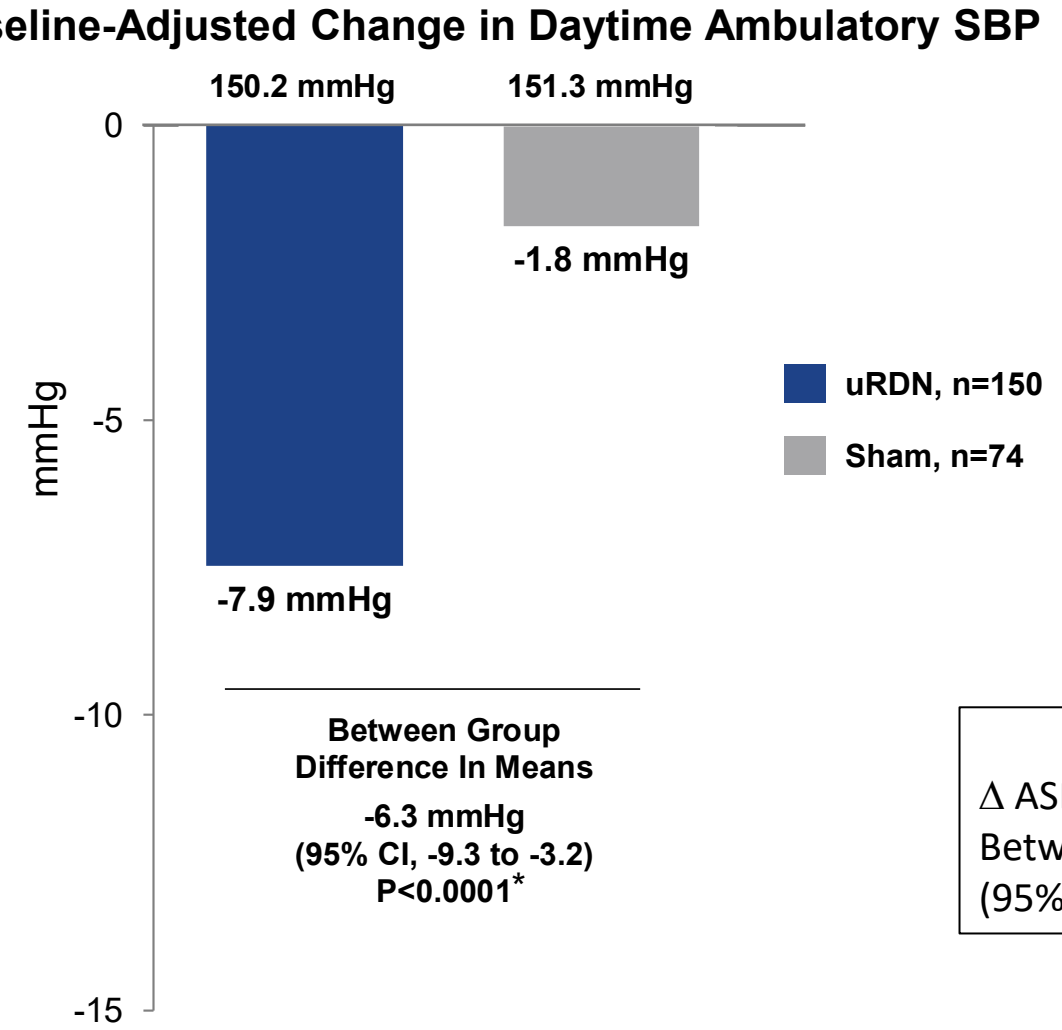
RADIANCE-HTN SOLO : Change in Daytime Ambulatory SBP at 2 Months vs. sham





Azizi et al. Lancet. 2018 Jun 9;391(10137):2335-2345.

RADIANCE II PIVOTAL STUDY :
Change in Daytime Ambulatory SBP at 2 Months



RADIANCE HTN SOLO

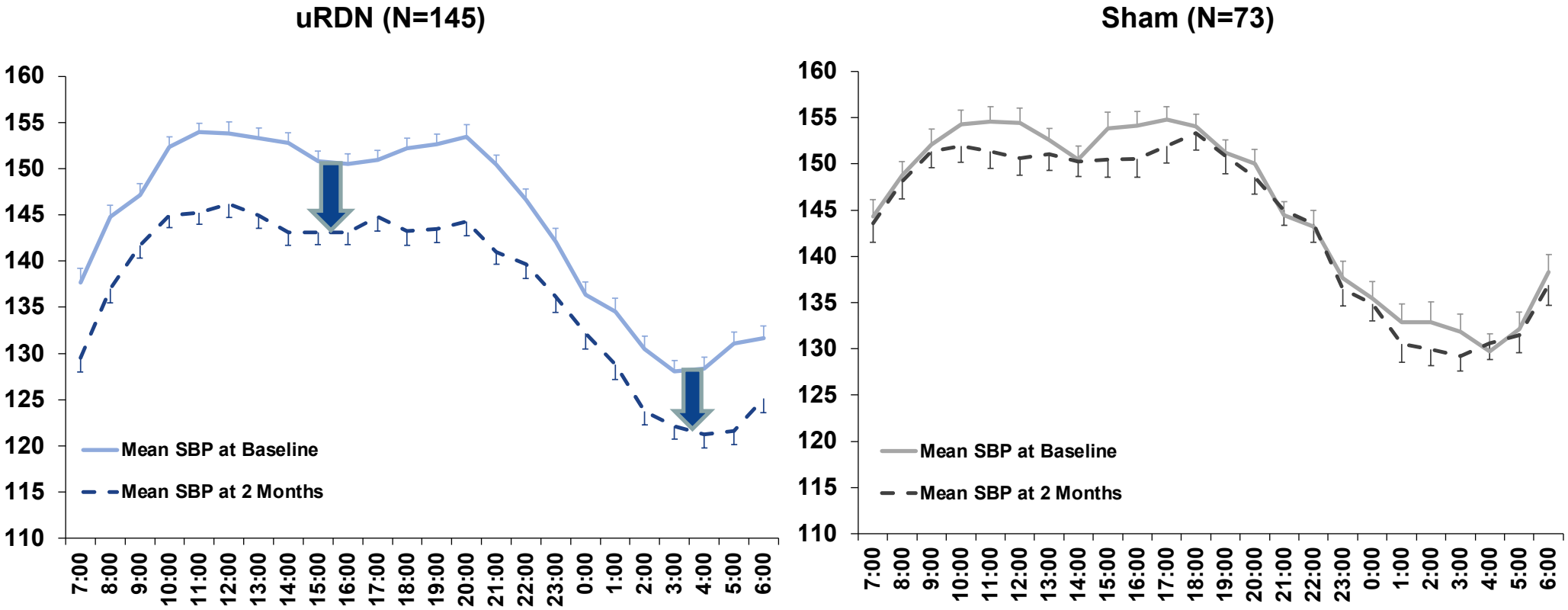
Δ ASBP: -8.5 mm Hg

Between group difference: - 6.3 mmHg

(95%CI: - 9.3 to -3.2 mmHg)

Azizi M. JAMA. 2023;329:651

ABPM profiles at Baseline and 2 Months



Mean Between Group Difference

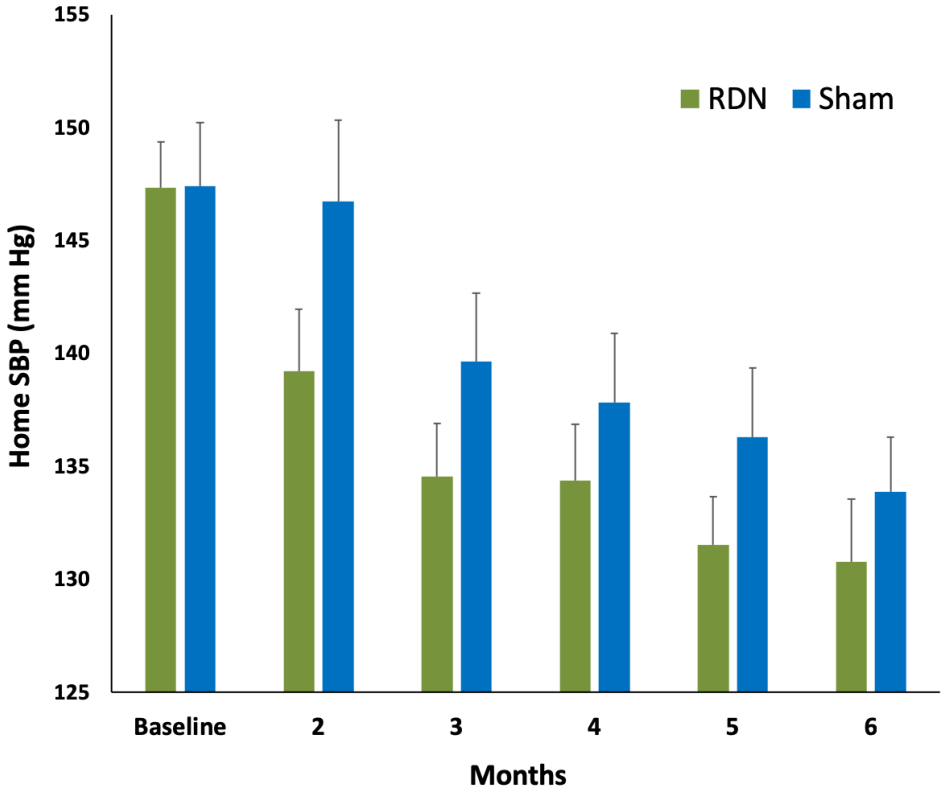
24h Ambulatory SBP
-6.2 mmHg
(95% CI, -9.1 to -3.4)
P<0.0001

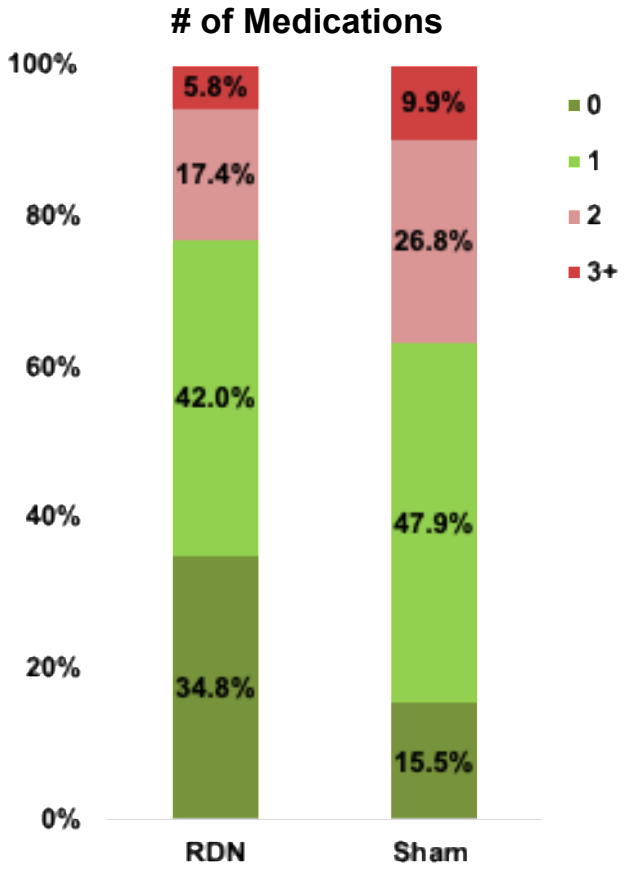
Nighttime Ambulatory SBP
-5.8 mmHg
(95% CI, -9.0 to -2.6)
P=0.0004

Patients that met escape criteria had baseline values carried forward

Azizi M. JAMA. 2023;329:651

Home Systolic BP Values and Changes from Baseline on medications



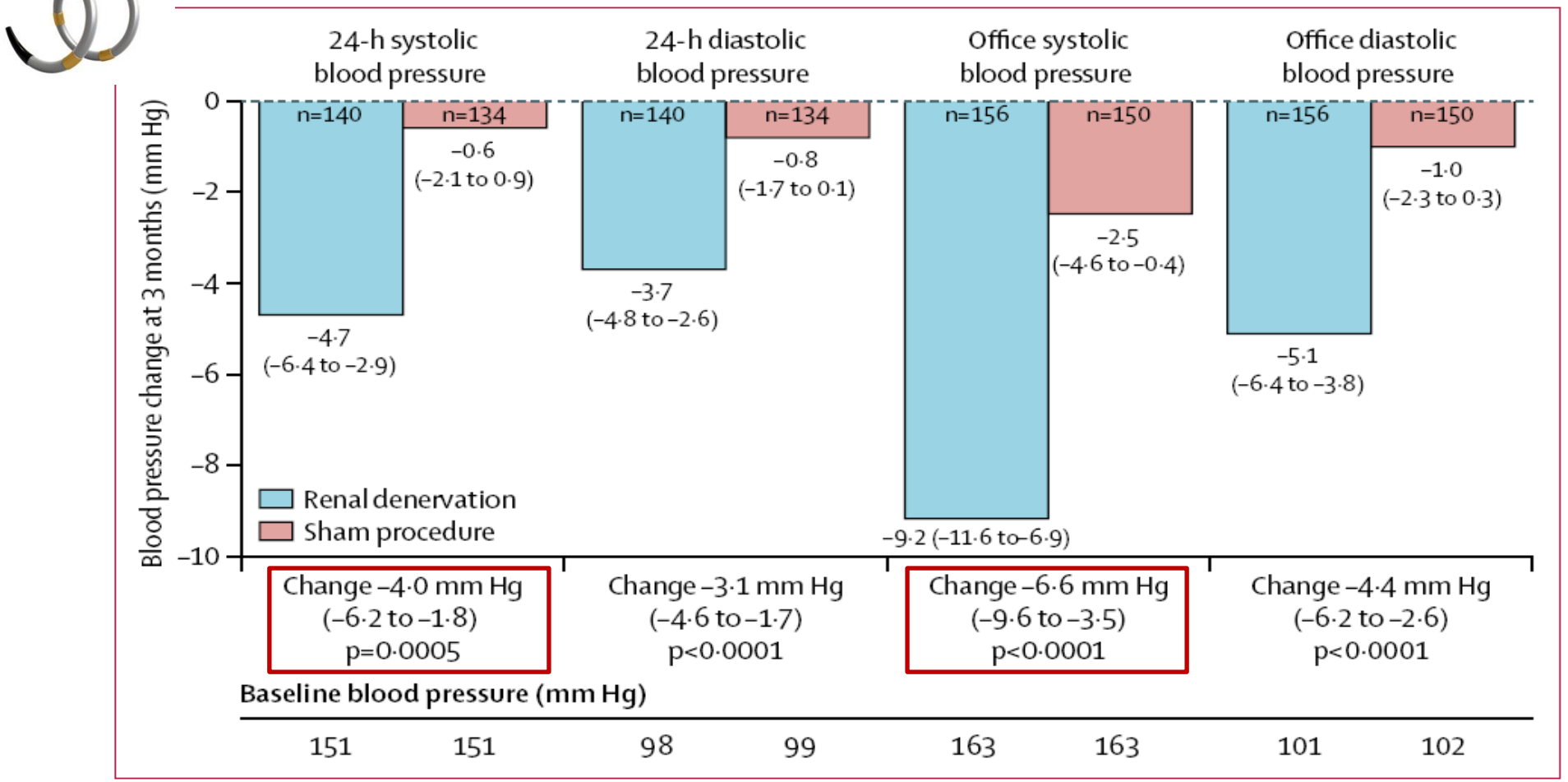


P Value for distribution = 0.055
P Value for being on no meds = 0.008

Overall between-group difference -6.9 mm Hg, 95% CI [-9.6,-4.1], p<0.001
from linear mixed model including visit x arm interaction term, adjusted for number of meds

Azizi M. Circulation 2019;139:2542–2553

Changes in 24-h and office BP from baseline to 3 months in SPYRAL HTN-OFF MED Pivotal

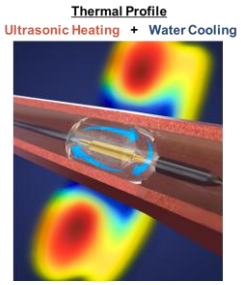


Böhm M et al. Lancet 2020;395:1444-1451.

ON-MED Study

RADIANCE-HTN TRIO

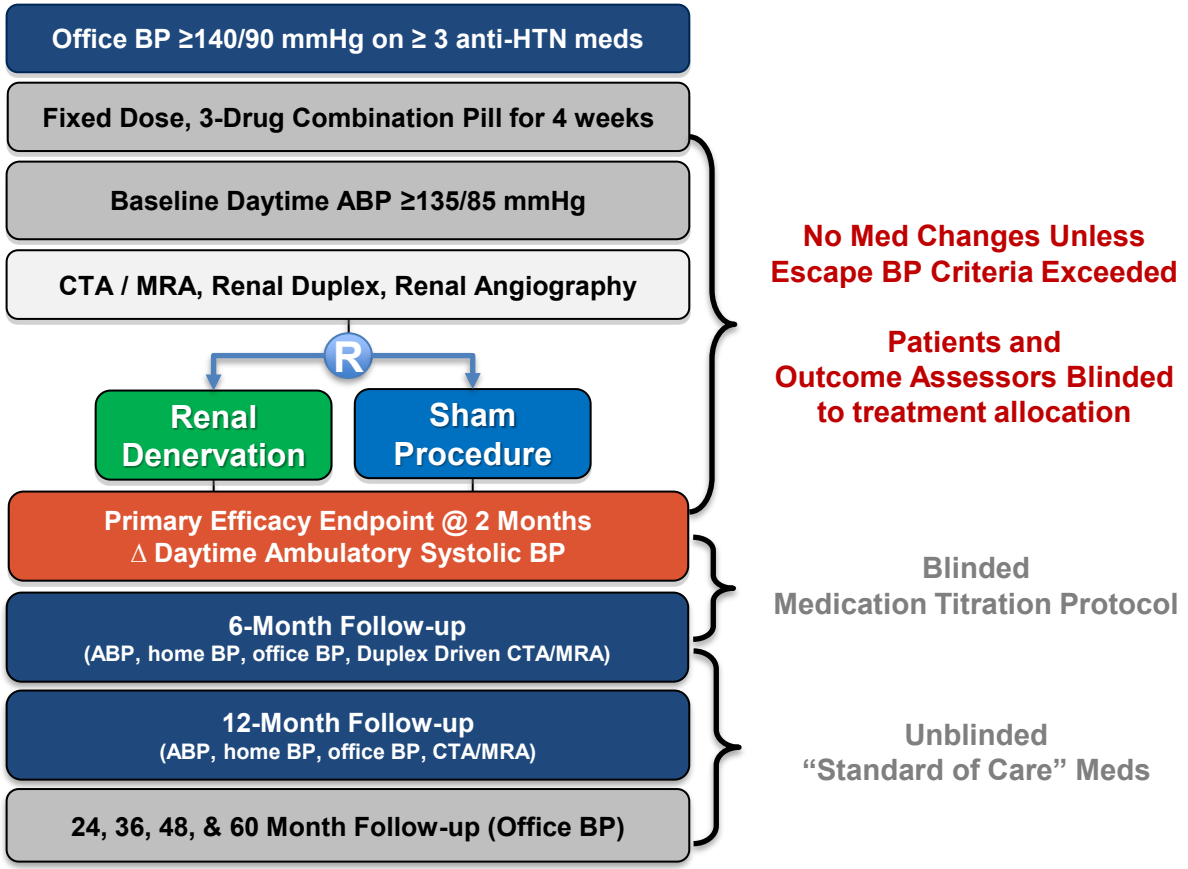
Multicenter, Blinded, Sham-Controlled trial
Powered to Demonstrate BP Lowering Effectiveness at 2M



Key Entry Criteria:

- Age 18-75 years
- Office BP ≥140/90 mmHg on ≥ 3 anti-HTN meds
- eGFR ≥ 40 mL/min/m^2
- Daytime ABP ≥135/85 mmHg after 4 weeks on guideline-recommended, fixed-dose, triple combination pill (TZD, ARB, CCB)
- Suitable renal artery anatomy

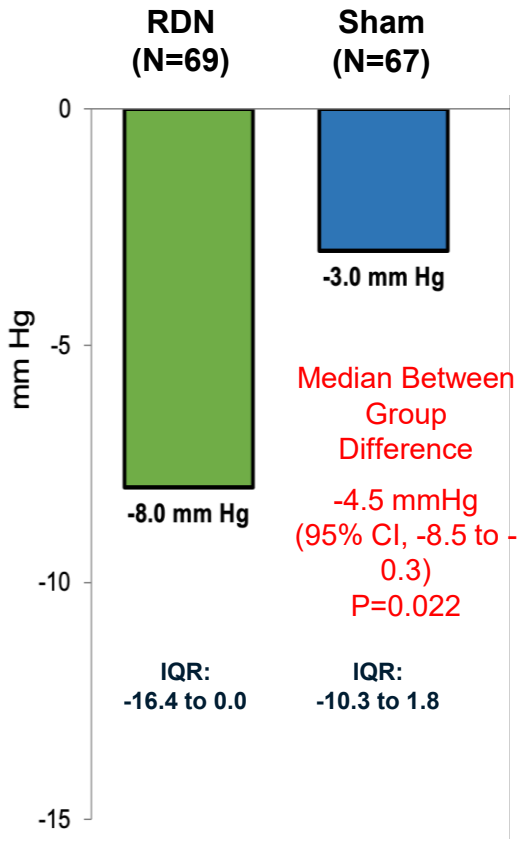
- No secondary hypertension aside from OSA
- No CV or cerebrovascular events within prior 3M
- No Type I or uncontrolled Type II diabetes



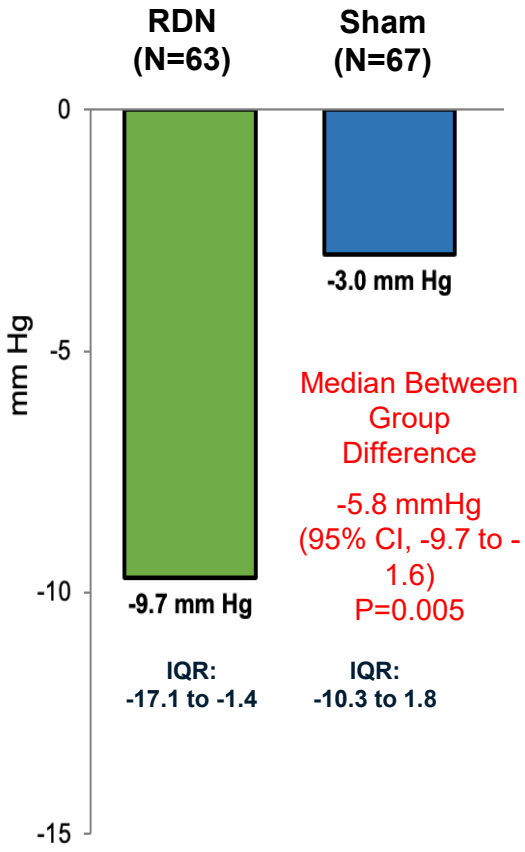
Azizi M et al. Lancet. 2021 Jun 26;397:2476-86

RADIANCE-HTN TRIO Primary Endpoint
Change in Daytime ASBP at 2M

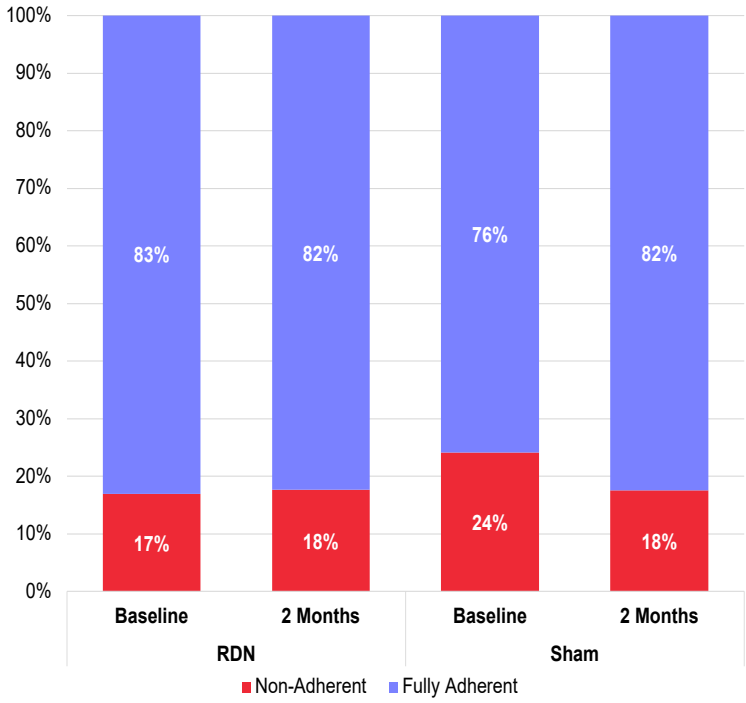
Intent-To-Treat Population



Complete ABPM Population



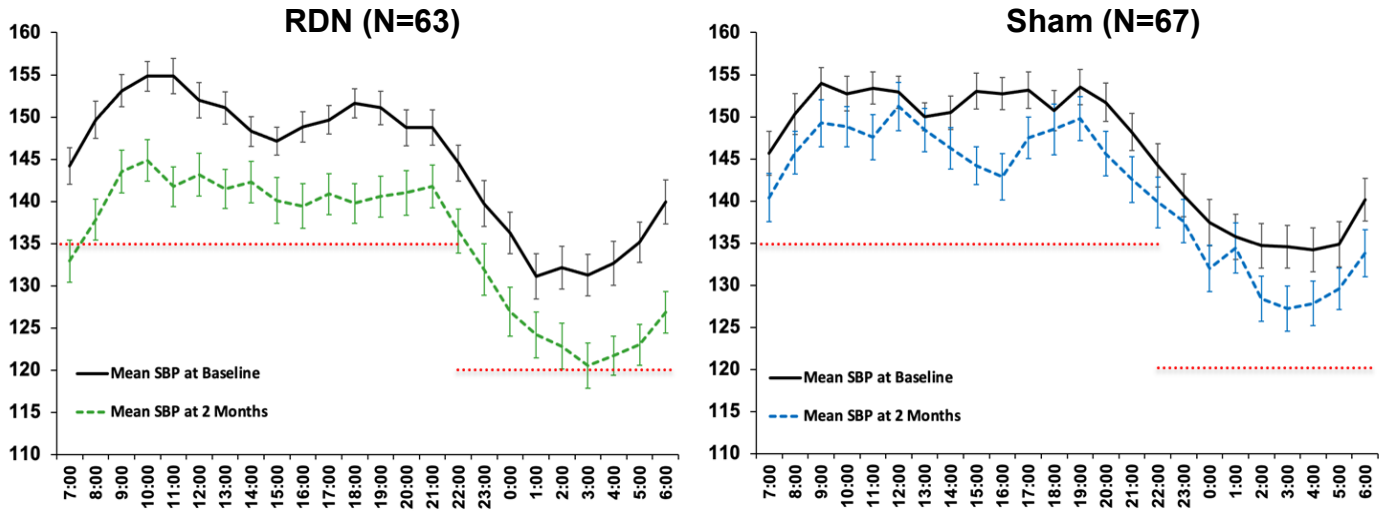
Medication adherence by urine LCMSMS



Azizi M et al. Lancet. 2021;397:2476

ABPM profiles at Baseline and 2 Months

Complete ABPM Population
(Imputed Escape)



Median Between Group Difference

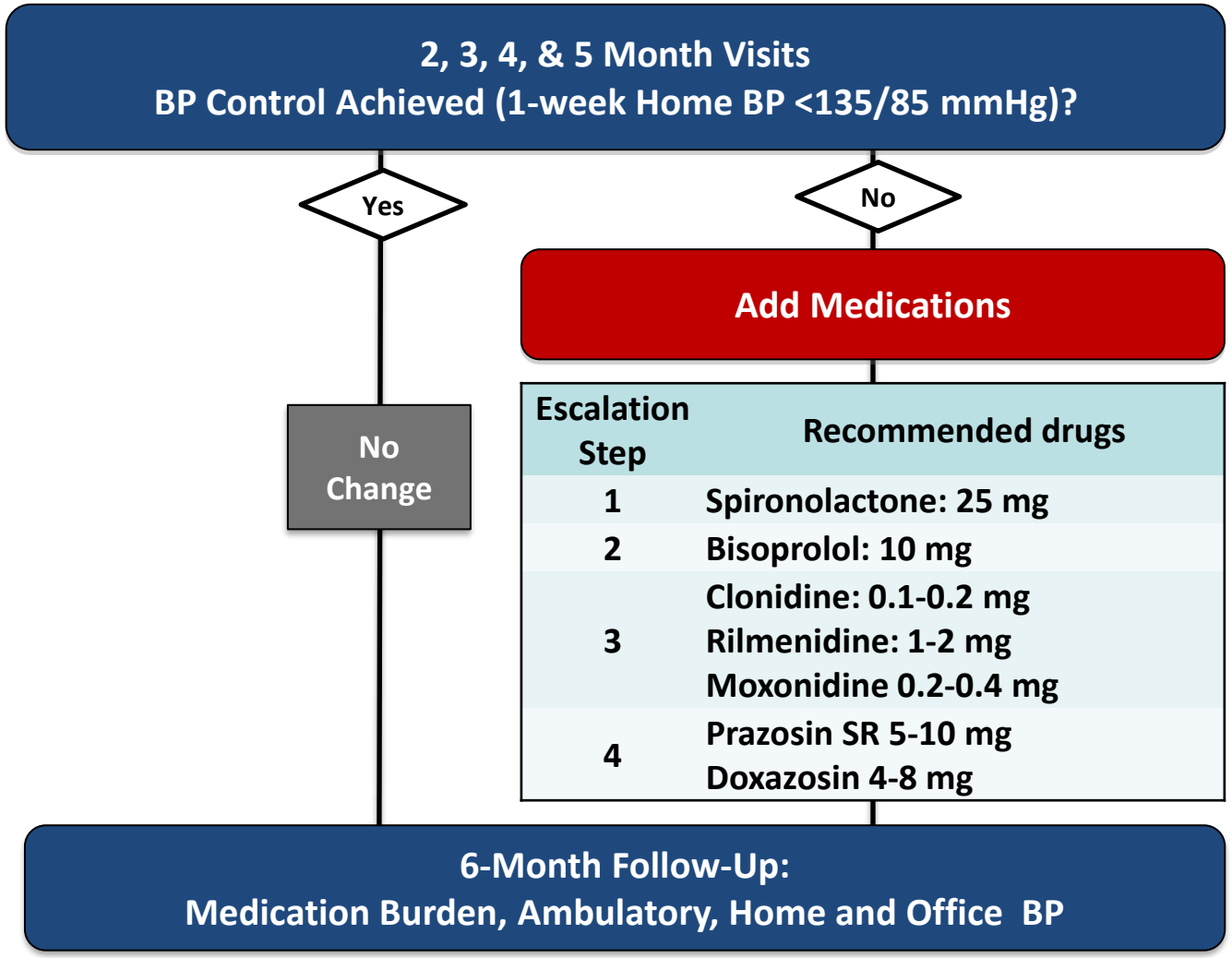
24h ABPM
-5.6 mmHg
(95% CI, -9.5 to -1.3)
P=0.0043*

Nighttime ABPM
-5.0 mmHg
(95% CI, -10.1 to 0.5)
P=0.015*

* Baseline-adjusted ANCOVA on the ranks

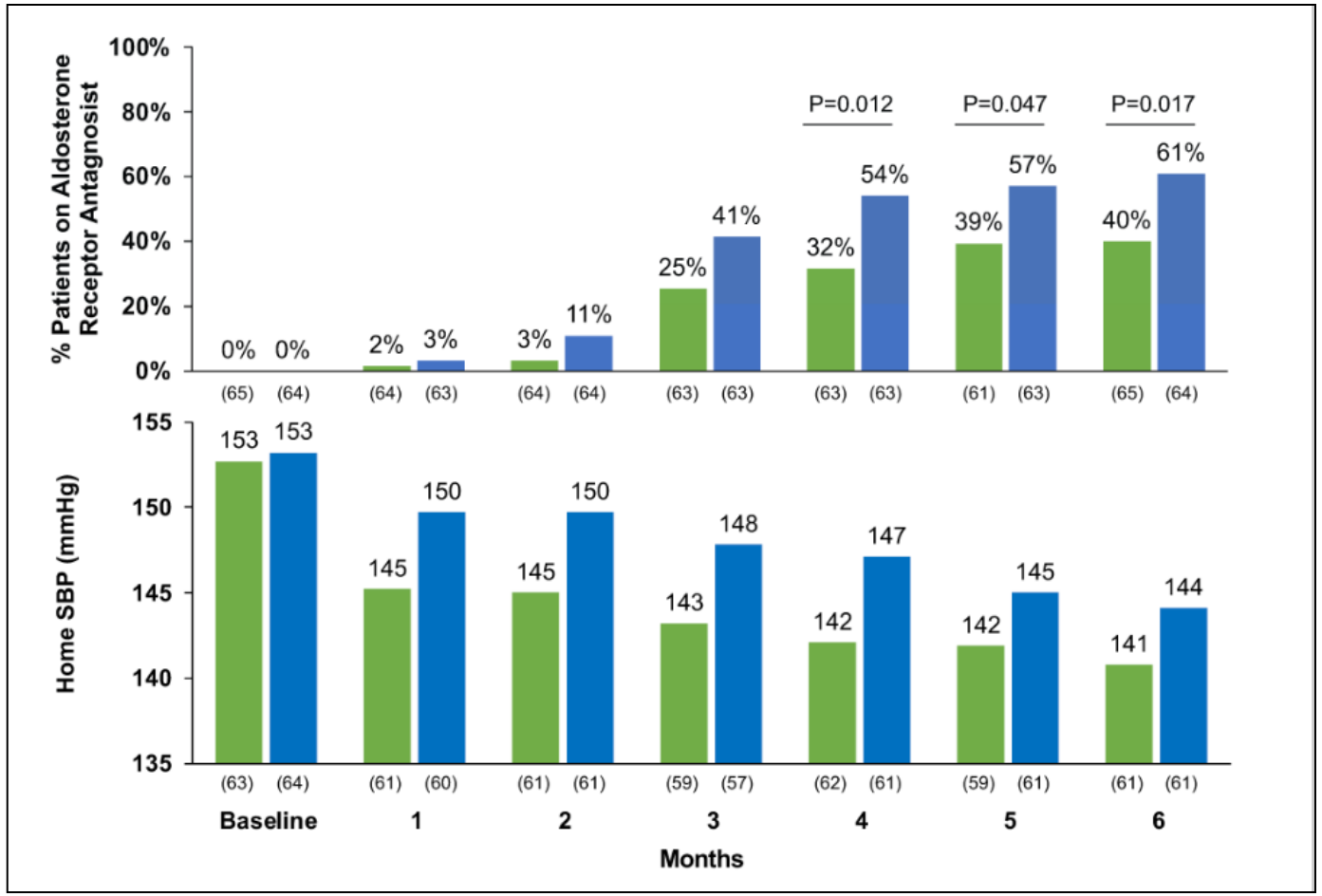
Azizi M et al. Lancet. 2021 Jun 26;397:2476-86

Blinded Medication Titration Protocol During Months 2-5



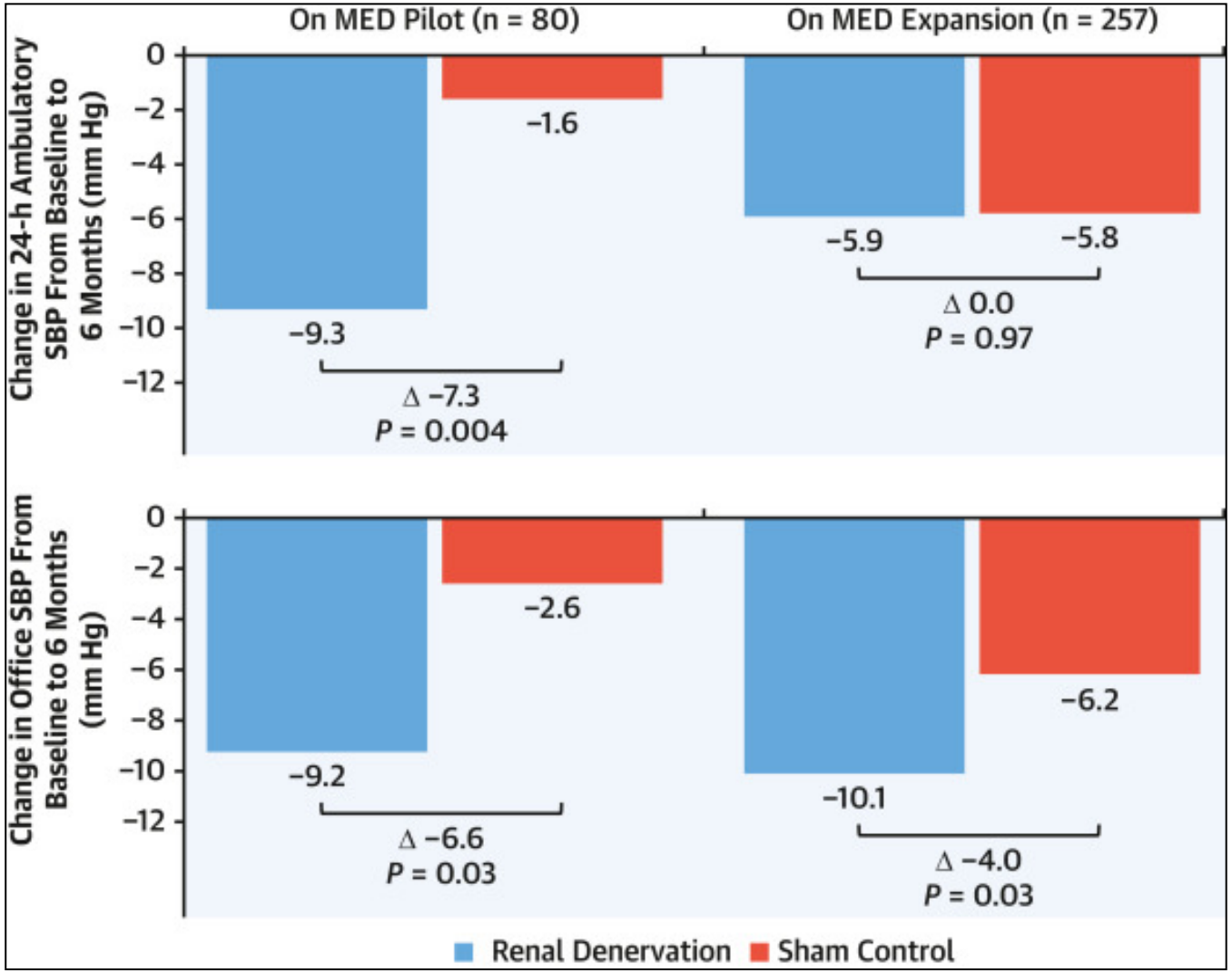
Medications use (aldosterone receptor antagonists) and home BP levels through 6 months

	RDN (n=65)	Sham (n=64)	P-Value
# Anti-HTN Meds at 6 months	3.8 ± 1.0	4.1 ± 1.1	0.078
Change in Anti-HTN Meds from Baseline	0.7 ± 1.0	1.1 ± 1.1	0.045



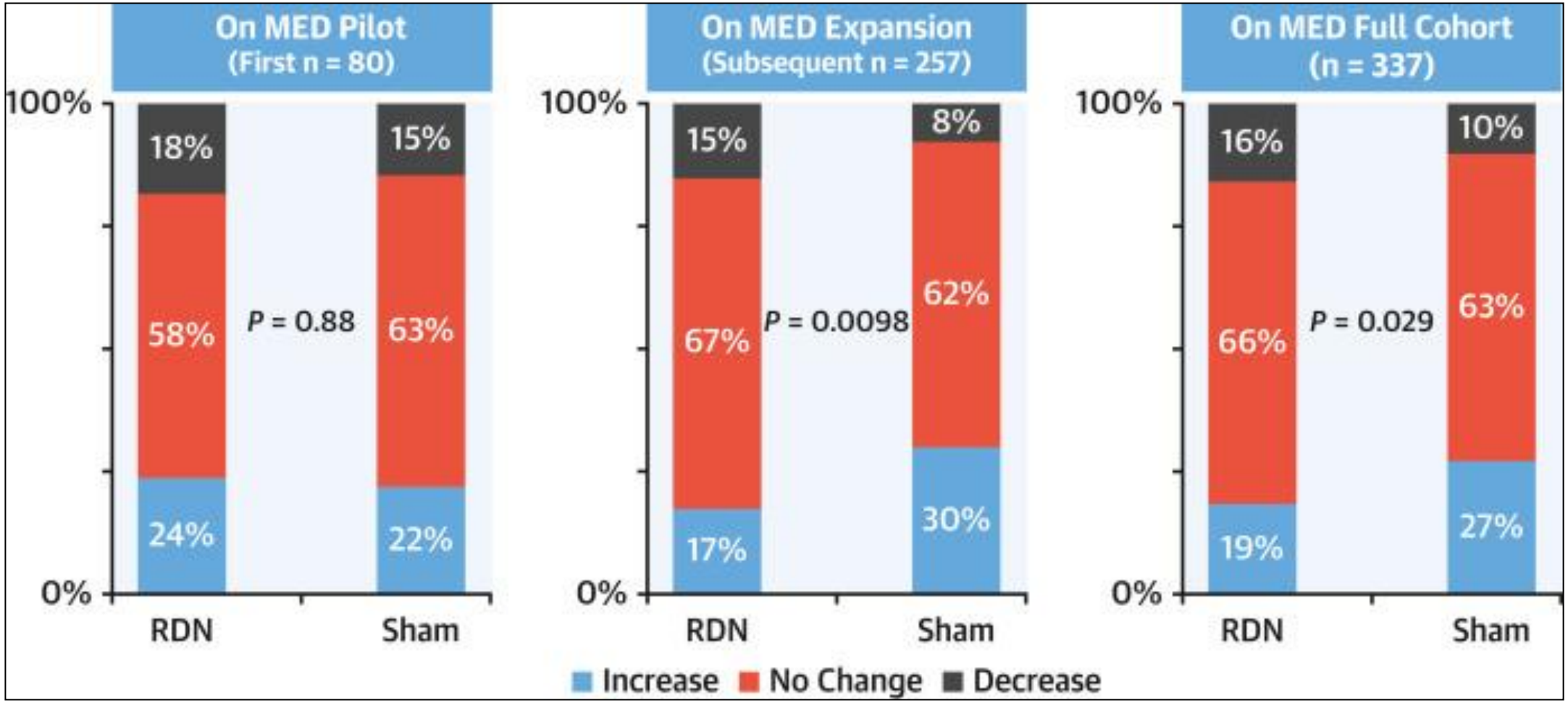
Azizi M et al. JAMA Cardiol 2022 ; 7: 1244

SBP Change in the Pilot and Expansion Cohorts in SPYRAL on-MED



Kandzari DE, J Am Coll Cardiol. 2023 Nov 7;82(19):1809-1823

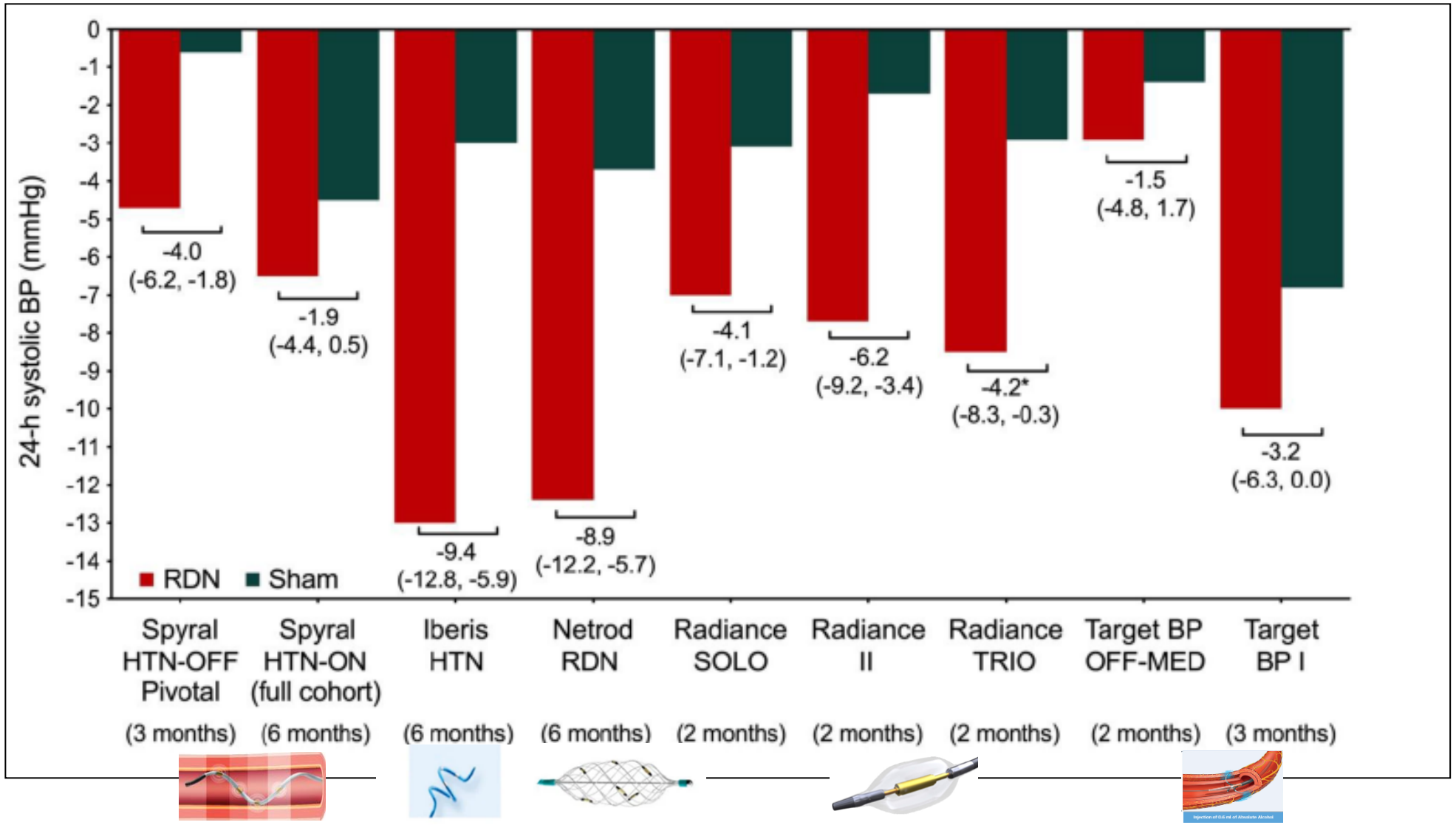
Antihypertensive Medication Burden Change Based on Drug Testing



Kandzari DE, J Am Coll Cardiol. 2023 Nov 7;82(19):1809-1823

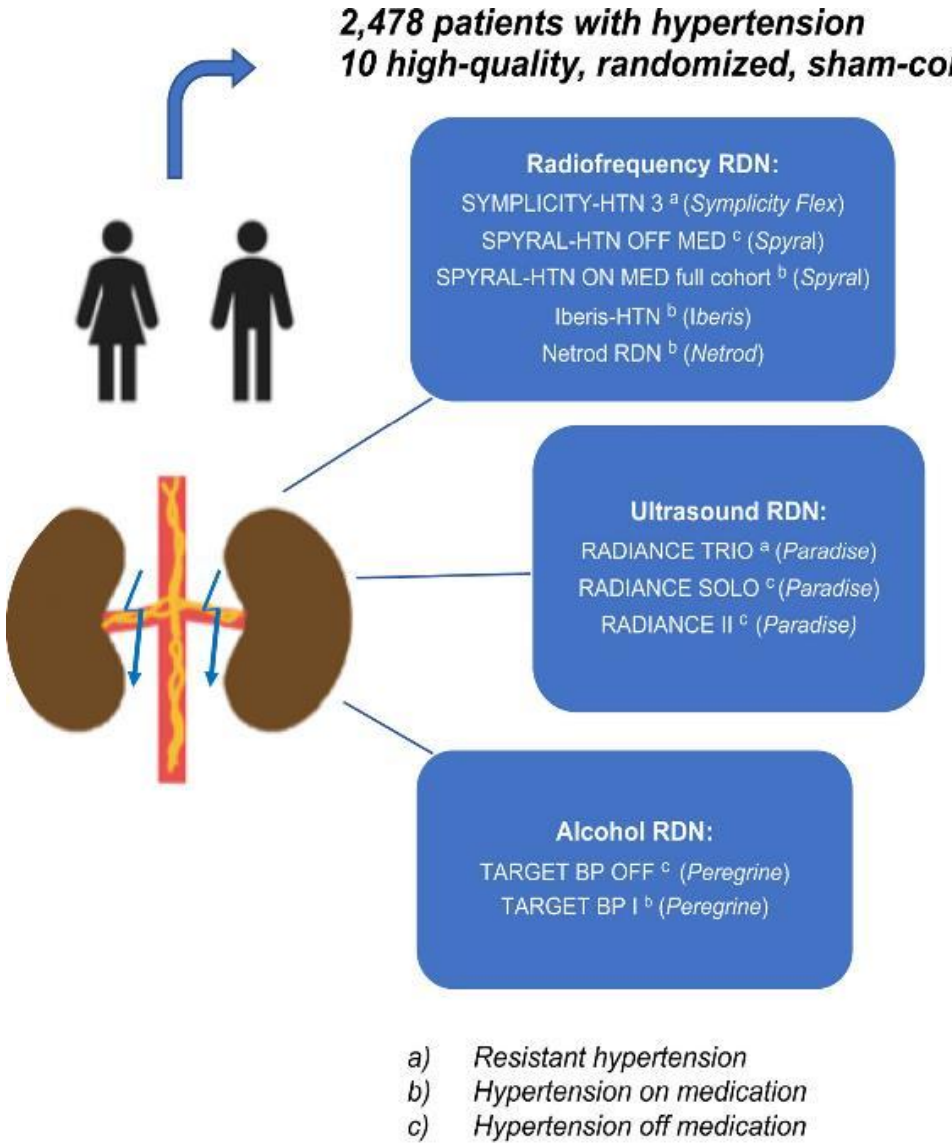
RCT results with other RDN catheters

Change in 24-h ambulatory SBP Following RDN in Second-Generation Sham-Controlled Trials



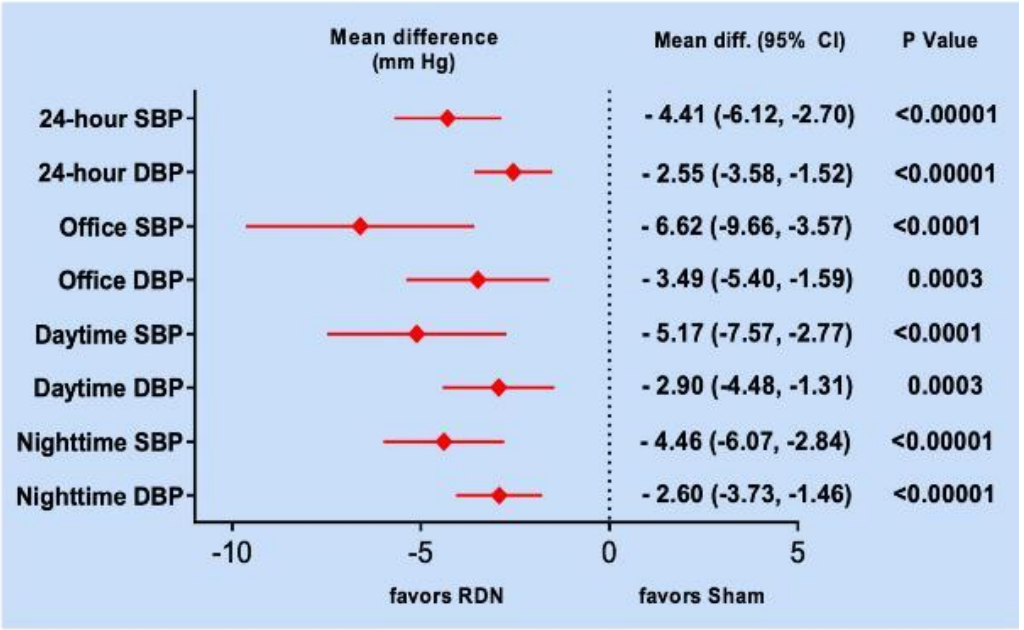
Lauder L. JACC Cardiovasc Interv. 2025;18:1833

Meta-Analysis of sham-controlled trials on RDN in Hypertension in 2024

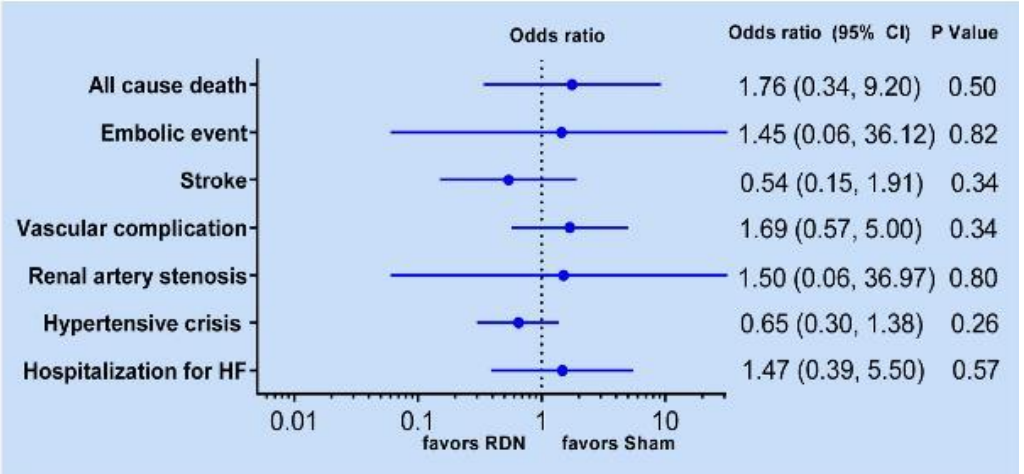


a) *Resistant hypertension*
b) *Hypertension on medication*
c) *Hypertension off medication*

Efficacy outcomes



Safety outcomes

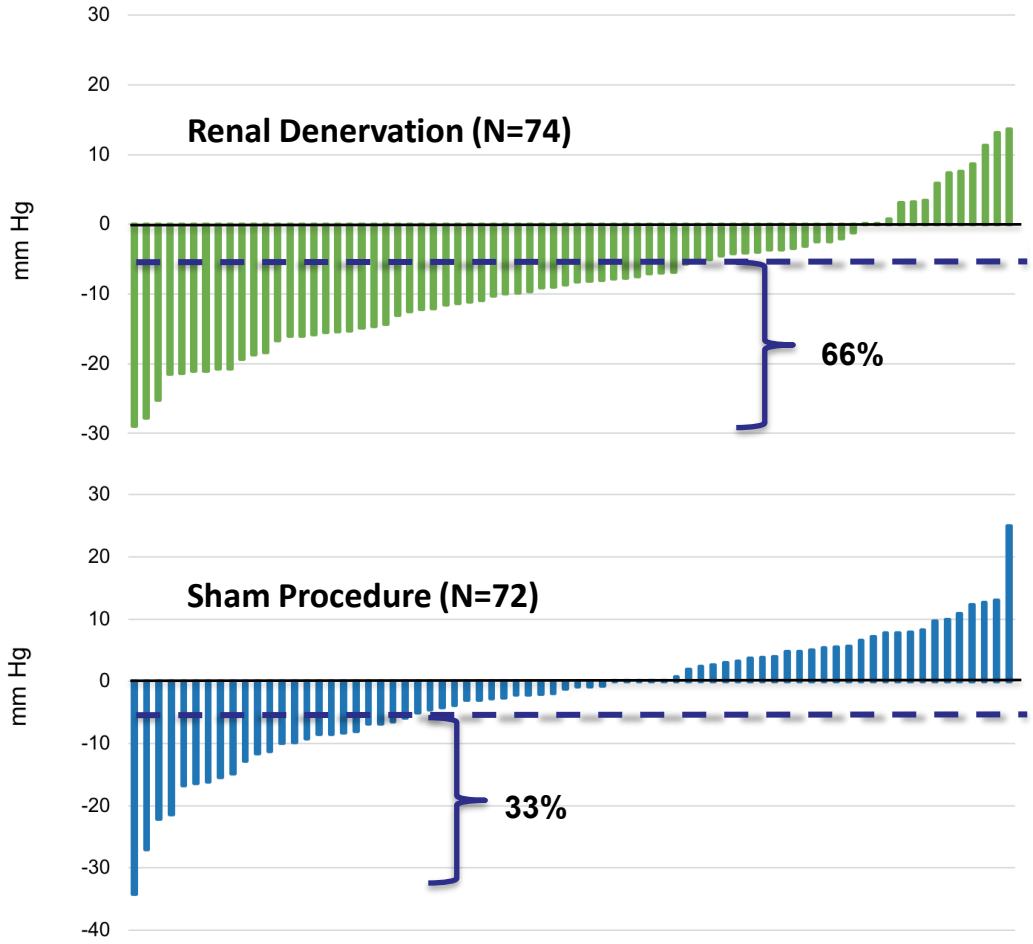


Vukadinović D Circulation 2024;150:1599

Predictors of BP response to RDN

Individual Patient Response at 2 Months

Change in Daytime Ambulatory Systolic BP at 2 Months (ITT Population)



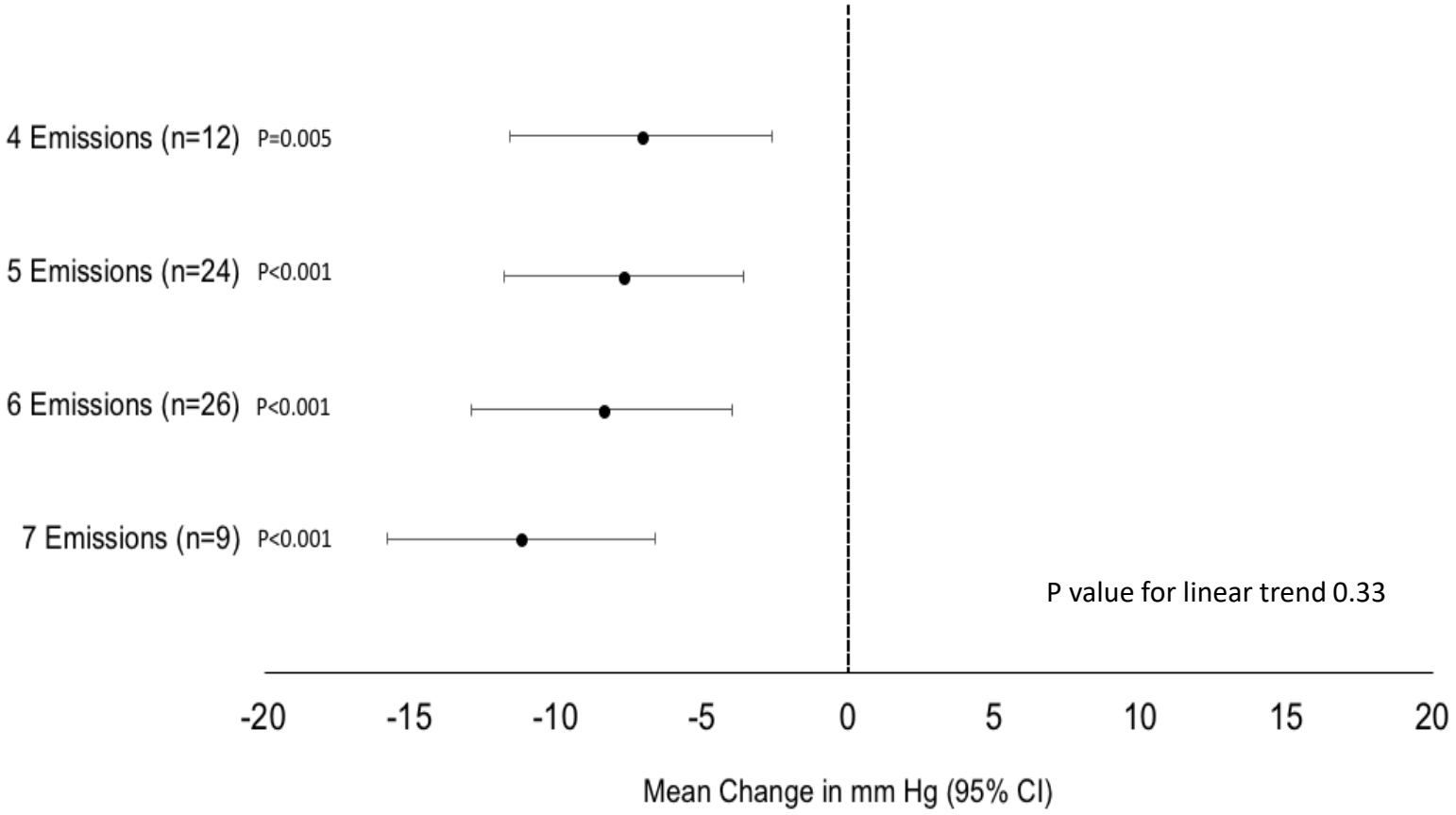
% Patients with ≥ 5 mm Hg Decrease

Renal Denervation: 66%
Sham Procedure: 33%

P<0.001

SOLO Trial: 2-Month Change in Daytime Systolic ABP

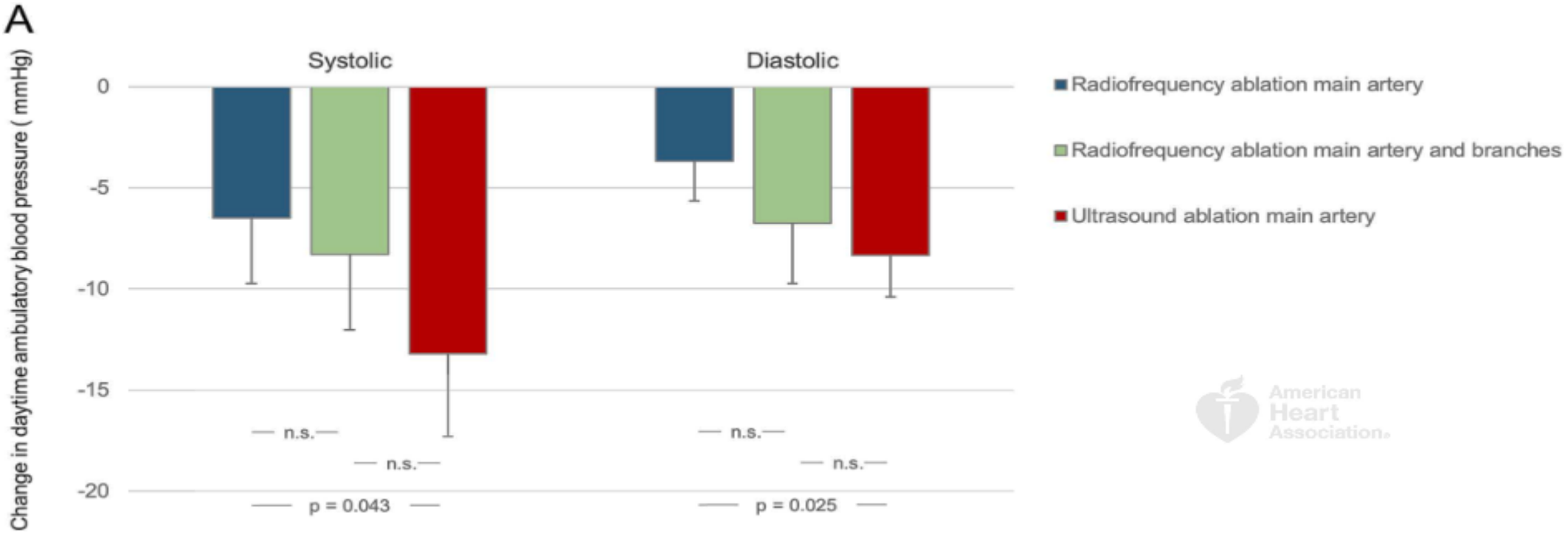
By Total Number of Ultrasound Emissions in RDN Group



All Numbers of Ablations Were Associated with Significant Reductions in 2-Month Daytime Systolic ABP

RADIOSOUND-HTN: RCT of Different of RDN Techniques in Patients with RHTN

120 pts with RHTN, 1:1 randomization
primary endpoint : change in daytime ambulatory SBP at 3 months.

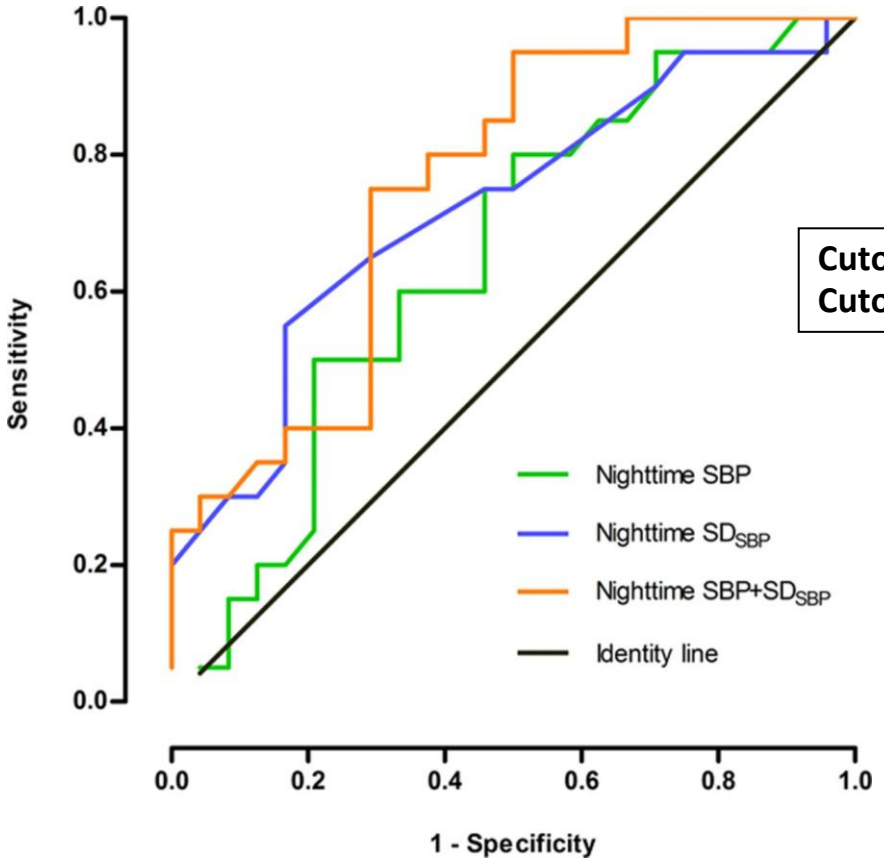


	All (n = 120)	RF main only (n = 39)	RF branches (n = 39)	US (n = 42)	*p*-value
Ablation points right renal artery	10.0 ±7.4	9.1 ±3.0	18.3 ±6.1	3.2 ±0.8	<0.001†
Ablation points left renal artery	9.2 ±6.7	8.1 ±2.2	16.8 ±6.0	3.2 ±0.9	<0.001†

Fengler et al. Circulation 2019;139:590–600

Baseline nighttime SBP and its SD to predict ambulatory BP responders after RDN

DENERHTN

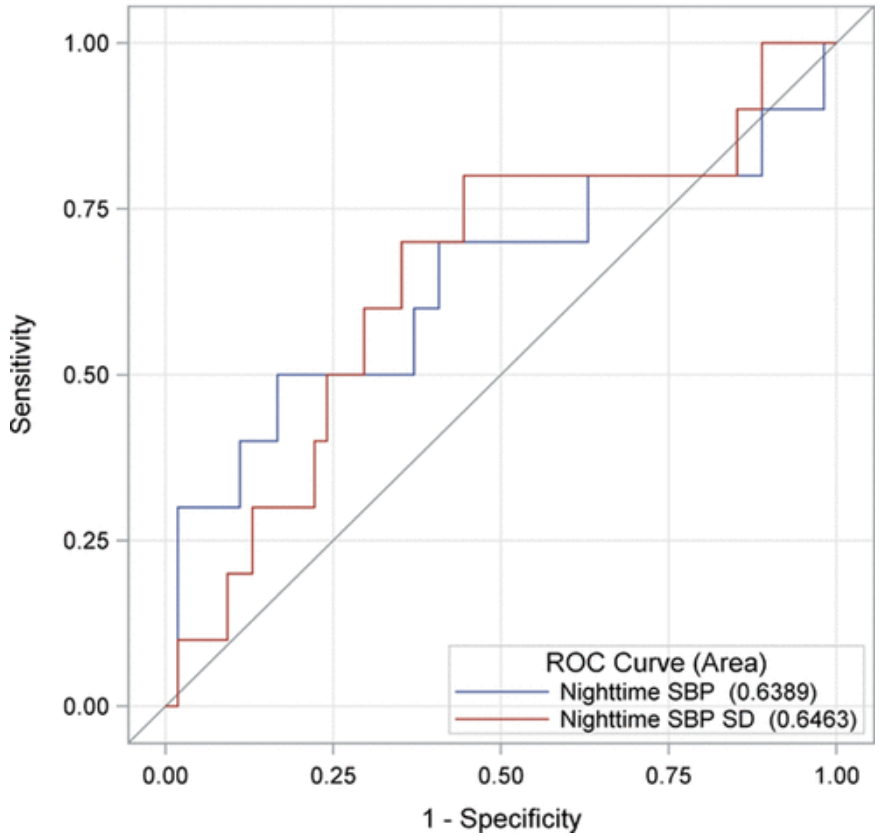


Cutoff baseline nighttime SBP: 136 mm Hg
Cutoff nighttime SD_{SBP} :12 mm Hg

AUC: 0.76 (95%CI: 0.61-0.90)

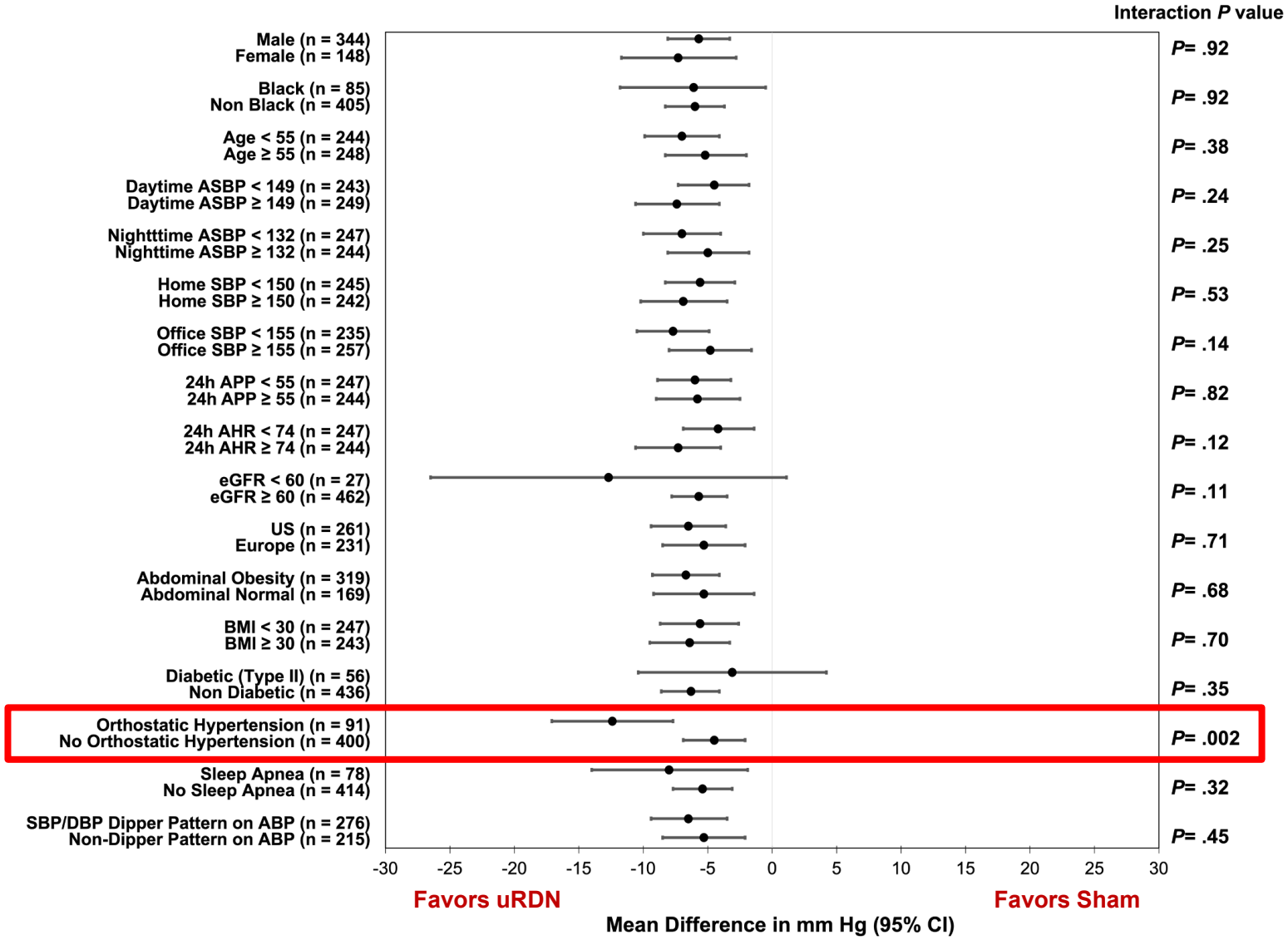
Gosse P . Hypertension. 2017;69:494-500

RADIANCE SOLO



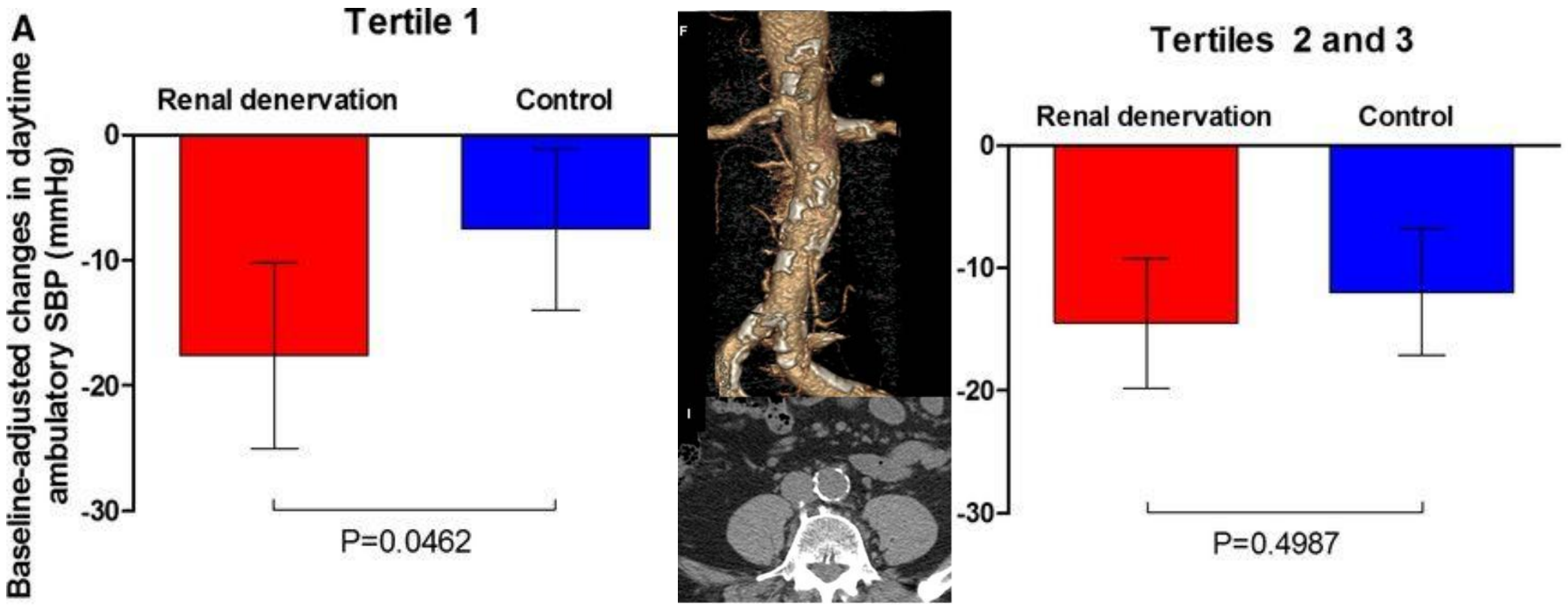
Gosse P . Hypertension 2021;77:529-536

RADIANCE Pooled Analysis: Change in Daytime Ambulatory SBP at 2 Months in Subgroups



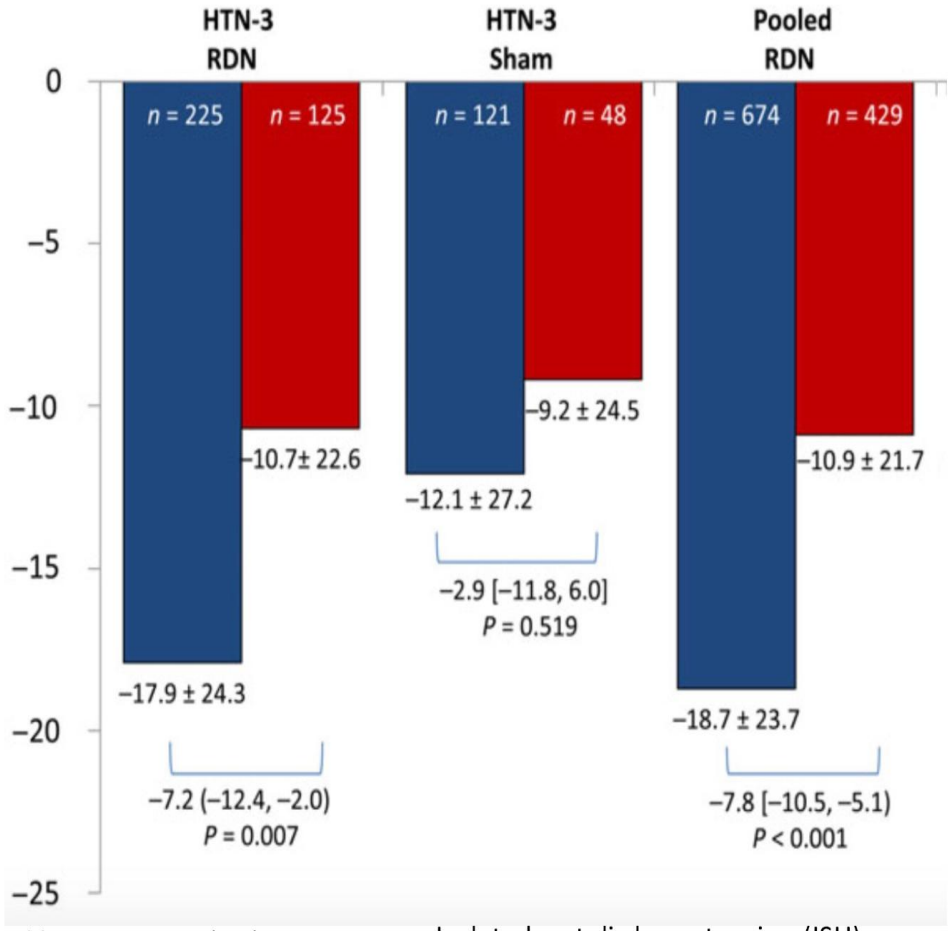
Kirtane A. JAMA Cardiol. 2023;8:464

Baseline-adjusted changes in daytime ambulatory SBP according to tertiles of AAC



Pierre-Yves Courand et al. J Am Heart Assoc 2017;6:e007062

Office SBP changes at 6 months in patients with CH and ISH



Combined hypertension (CH):

- SBP >140 mmHg, **DBP >90 mmHg**

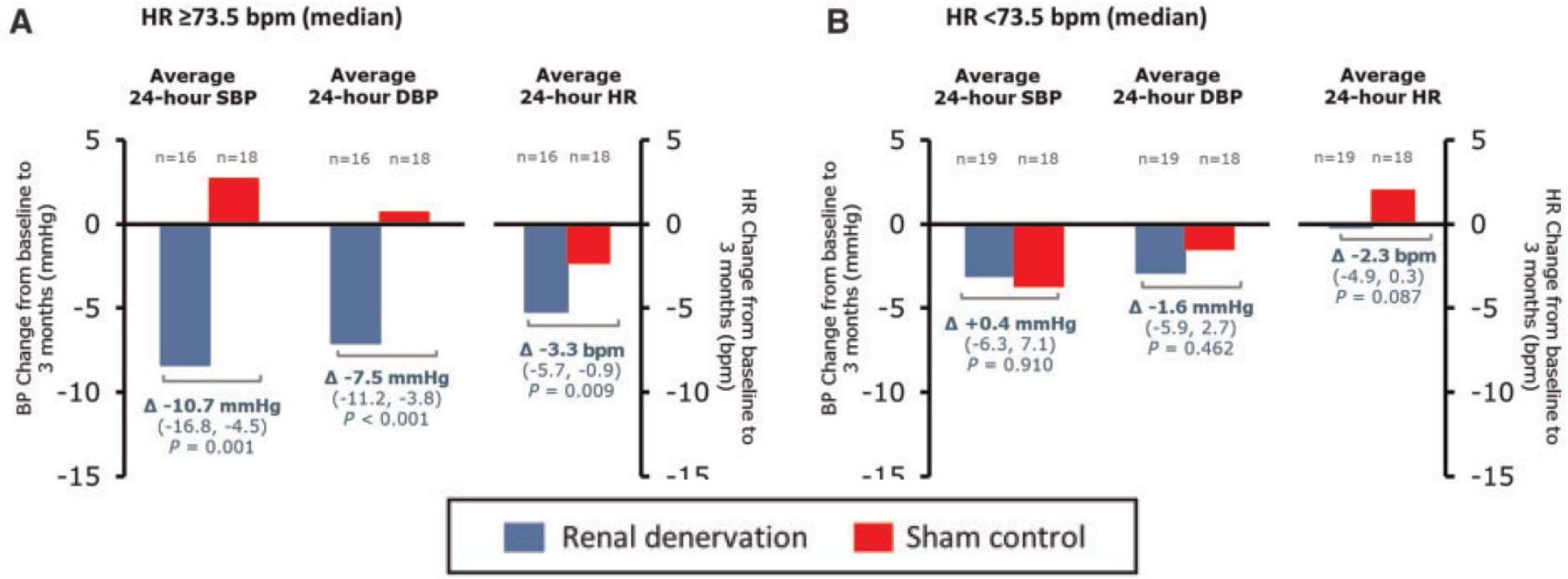
Isolated systolic hypertension (ISH):

- SBP >140 mmHg, **DBP <90 mmHg**

Mahfoud F et al. Eur Heart J 2016

Baseline 24-h HR : a predictor of changes in BP ?

	Baseline		3 months		Change at 3 months		
	RDN (*N* = 35)	Sham (*N* = 36)	RDN (*N* = 35)	Sham (*N* = 36)	RDN (*N* = 35)	Sham (*N* = 36)	Mean difference: RDN vs. sham[a]
24-h HR (b.p.m.)	72.9 ± 11.0	74.4 ± 11.7	70.4 ± 8.5	74.2 ± 9.6	-2.5 ± 5.3 (-4.3 to -0.7)	-0.2 ± 4.1 (-1.5 to 1.2)	-2.7 (-4.5 to -1.0) *P* = 0.003



Bohm M. Eur Heart J 2019; 40: 743

Potential predictors of BP response to RDN

Patient characteristics

- Age
- Ethnicity
- Obesity
- Sleep apnea
- Chronic kidney disease
- Antihypertensive medication
- Poor drug adherence
- Renal artery diameter

Hemodynamic parameters

- Basal heart rate and heart rate variability
- Nighttime systolic BP and variability
- Pulse wave velocity
- Central pulse pressure
- Aortic calcification
- Baroreceptor sensitivity

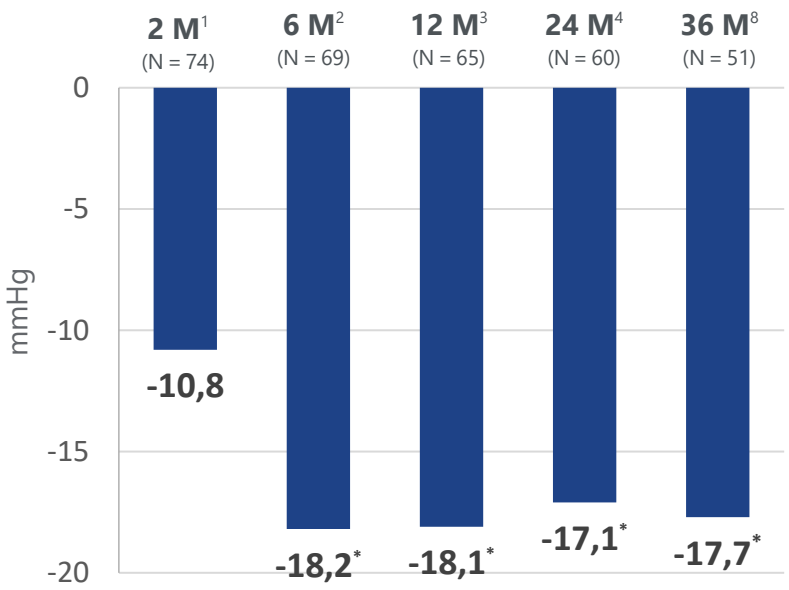
Lauder L, Prog Cardiovasc Dis. 2021;65:76

Long term efficacy results

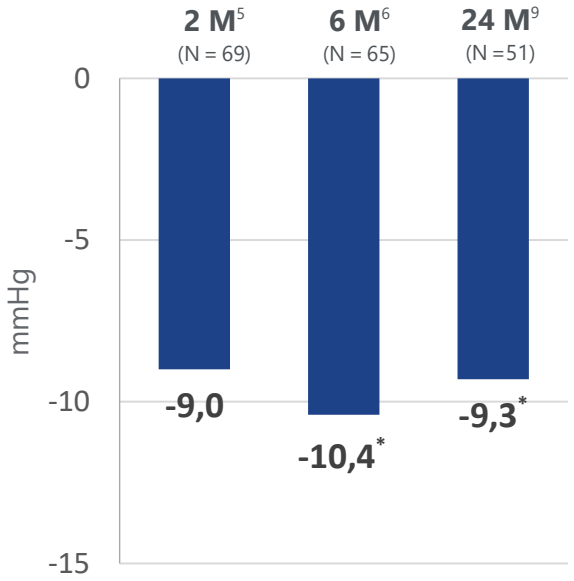
RADIANCE-HTN and ACHIEVE Studies:

Office Systolic Blood Pressure up to 36 Months

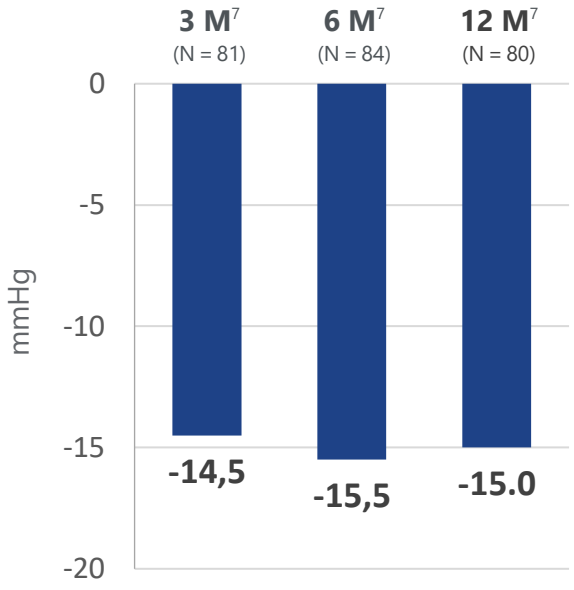
RADIANCE-HTN SOLO



RADIANCE-HTN TRIO



ACHIEVE Study



Long-term Durability Demonstrated in the RADIANCE-HTN and ACHIEVE Studies

* Medication titrated

1. Azizi et al. *Lancet*. 2018 Jun 9;391(10137):2335-2345. 2. Azizi et al. *Circulation*. 2019;139:2542–2553. 3. Azizi et al. *JACC Cardiovasc Interv*. 2020 Dec 28;13(24):2922-2933. 4. Rader et al. TCT 2021 5. Azizi et al. *Lancet*. 2021;397:2476-2486.
6. Kirtane et al. TCT 2021. 7. Daemen et al. J *Hypertens*. 2019 Sep;37(9):1906-1912.

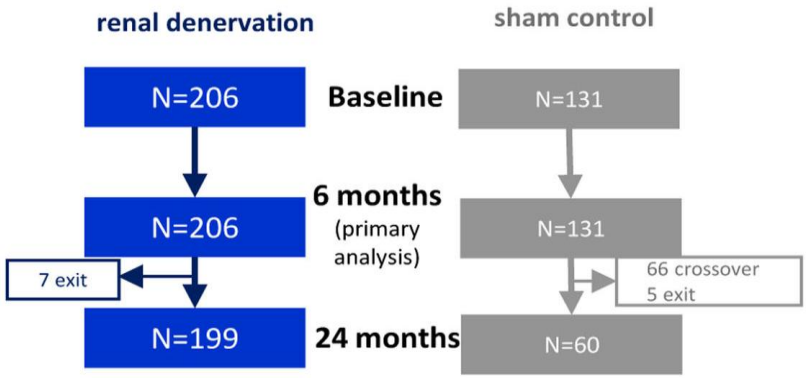
24-Month Results From the SPYRAL HTN-ON MED Trial

Long-Term Follow-up: SPYRAL HTN-ON MED Trial

TRIAL

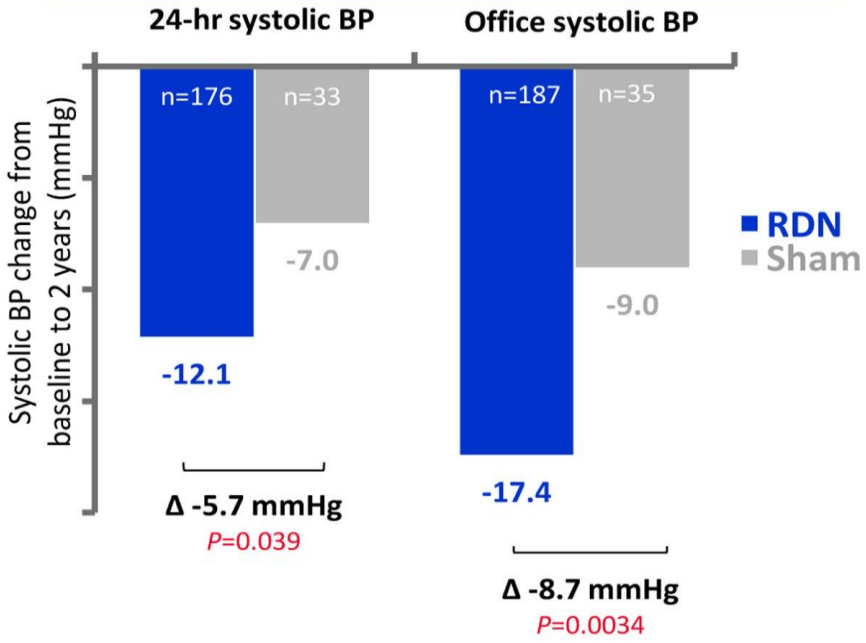
N=337; uncontrolled hypertension patients:

- **Office BP**: systolic 150 -180 / ≥ 90 diastolic mmHg
- **24-hr mean BP**: systolic 140 – 170 mmHg
- **Prescribed 1-3 antihypertensive medications**



- **Drug testing suggested more antihypertensive medications in sham control at 2 years**
- **No renal artery stenosis >70% or reintervention through 2 years**

BP Changes at 2 Years

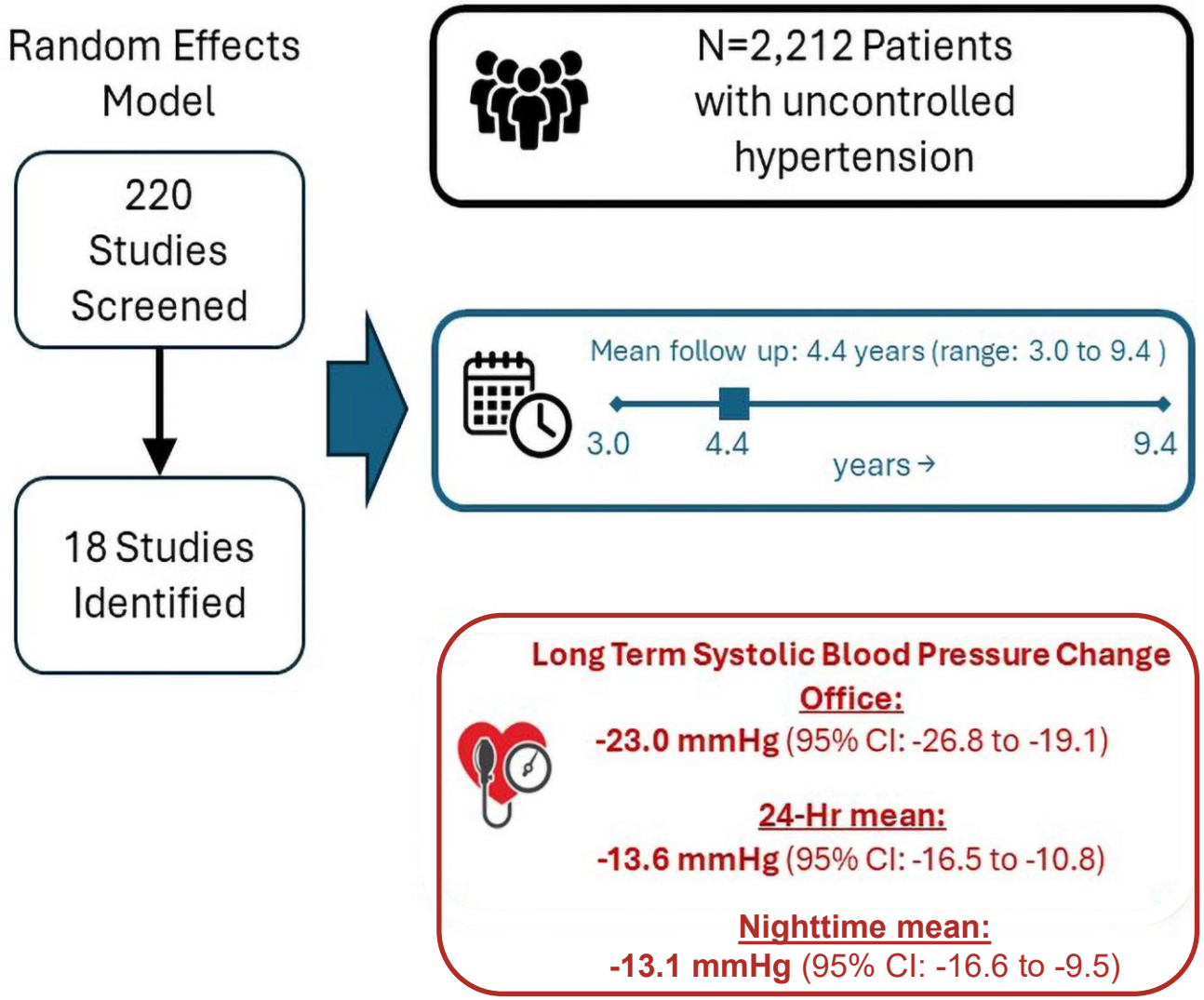


Conclusions

Renal denervation produced greater 24-hr and office systolic BP reductions at 2 years compared with sham control, despite higher medications in sham control.

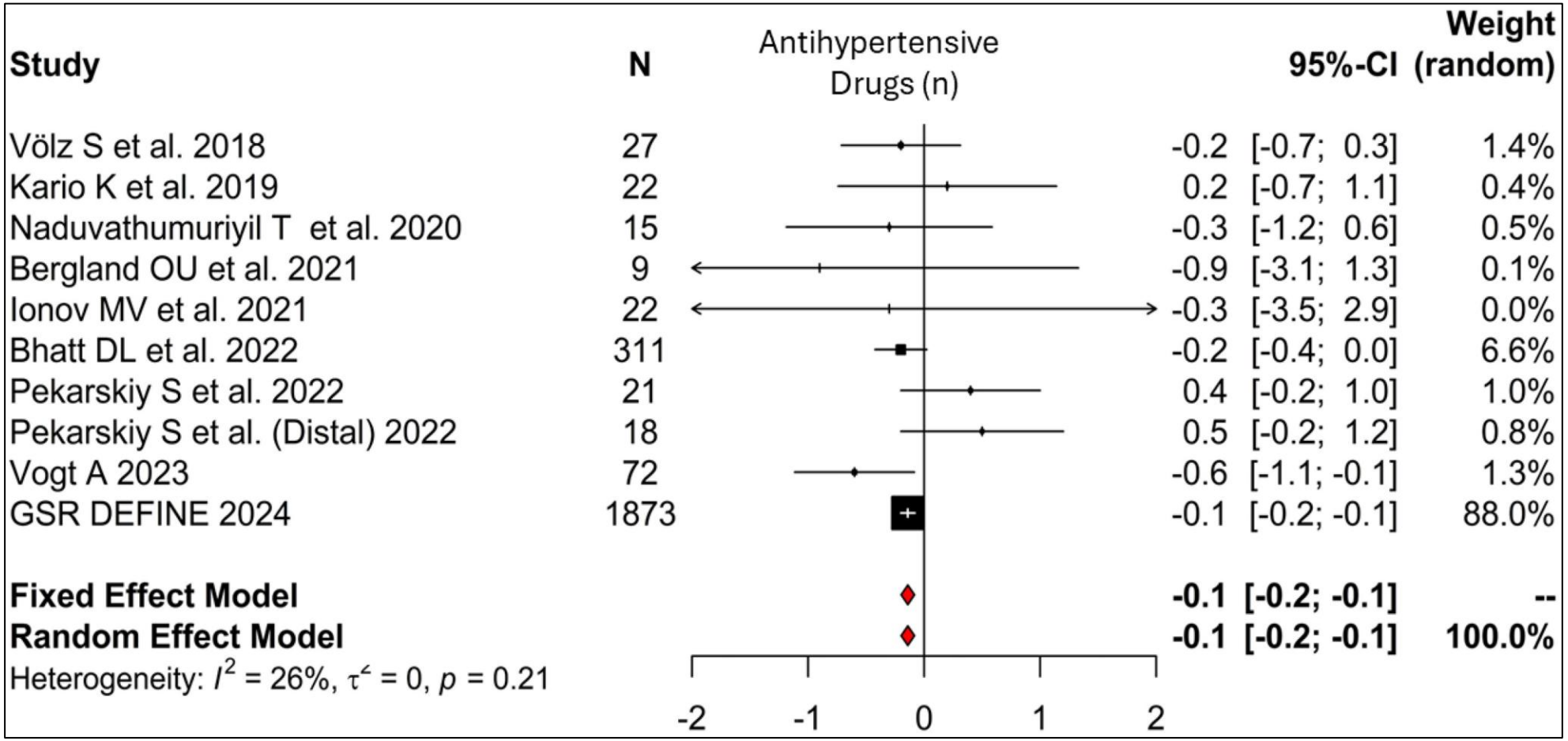
Kandzari DE, et al. Circ. Cardiovasc Interv. 2025;18:e015194

Long-term outcomes following RF-RDN



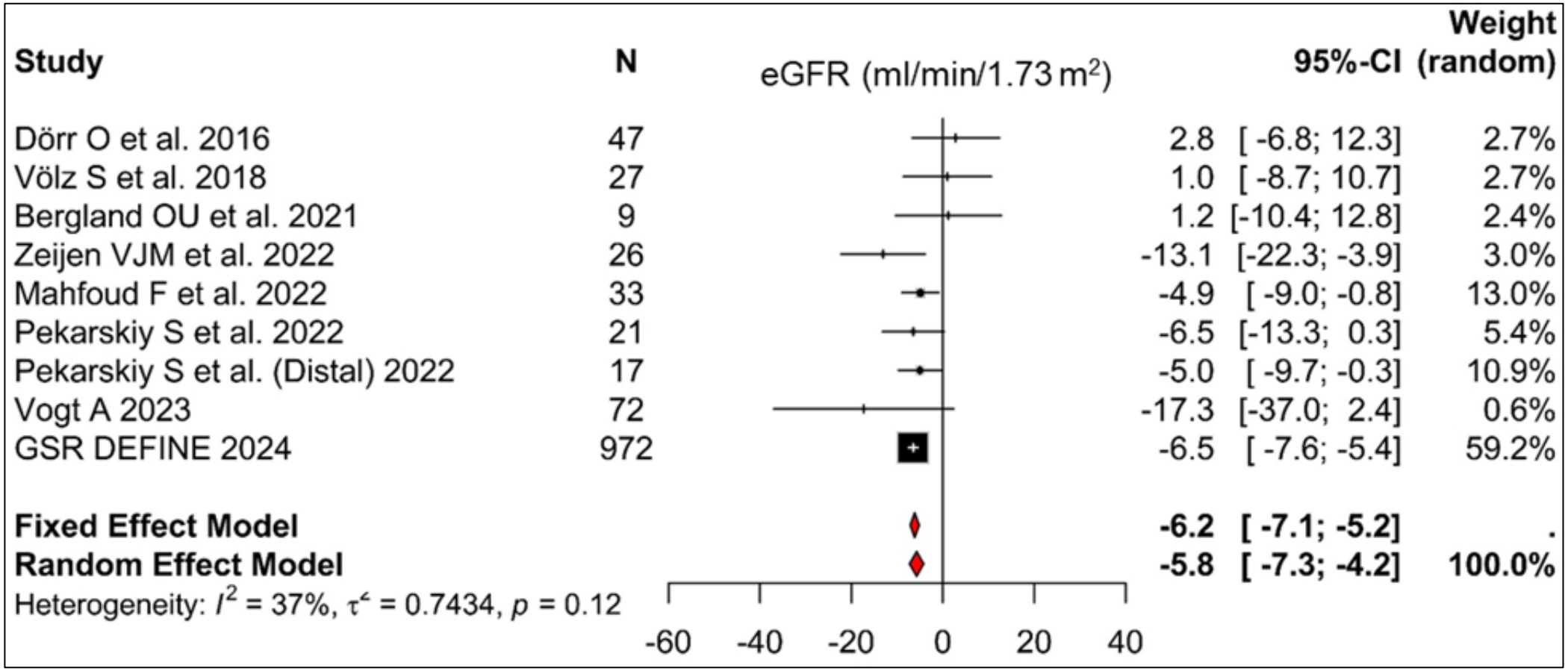
Mahfoud F et al. Eur J Prev Cardiol. 2025. ePub

Long-term changes in the number of prescribed anti-hypertensive drugs



Mahfoud F et al. Eur J Prev Cardiol. 2025. ePub

Long-term changes in eGFR



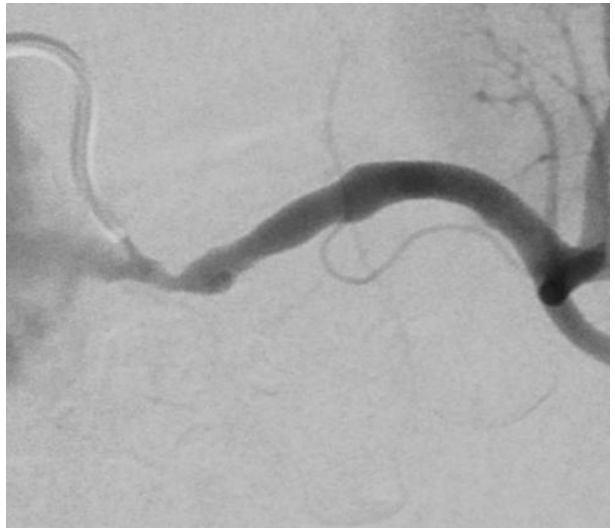
Mahfoud F et al. Eur J Prev Cardiol. 2025. ePub

Safety results in the Global Symplicity registry

	6 months (number at risk[a]: 2237)	1 year (number at risk[a]: 2112)	2 years (number at risk[a]: 1917)	3 years (number at risk[a]: 1345)
Death	0.5 (10)	1.3 (28)	2.8 (54)	4.1 (59)
Cardiovascular events				
Cardiovascular death	0.3 (6)	0.8 (16)	1.5 (28)	2.0 (29)
Stroke	0.7 (15)	1.3 (27)	2.1 (41)	3.2 (47)
Hospitalization for new onset heart failure	0.7 (16)	1.1 (24)	2.0 (38)	3.2 (46)
Hospitalization for atrial fibrillation	0.7 (15)	1.5 (32)	2.4 (46)	3.0 (45)
Hospitalization for hypertensive crisis/hypertensive emergency	0.8 (17)	1.1 (24)	1.8 (36)	2.6 (40)
Myocardial infarction	0.7 (16)	1.1 (23)	1.6 (31)	2.2 (33)
Renal events				
New onset end-stage renal disease	0.2 (4)	0.4 (9)	1.0 (19)	1.6 (23)
Serum creatinine elevation >50% mg/dL	0.4 (9)	0.9 (19)	1.2 (24)	1.5 (24)
New artery stenosis (>70% diameter stenosis)	0.05 (1)	0.1 (3)	0.2 (4)	0.3 (4)
Post-procedural events				
Non-cardiovascular death	0.1 (2)	0.3 (7)	1.0 (19)	1.6 (22)
Renal artery reintervention	0.2 (5)	0.4 (8)	0.4 (9)	0.6 (10)

Mahfoud F. Eur Heart J. 2019 Mar 21. pii: ehz118.

Renal artery stenosis following renal denervation



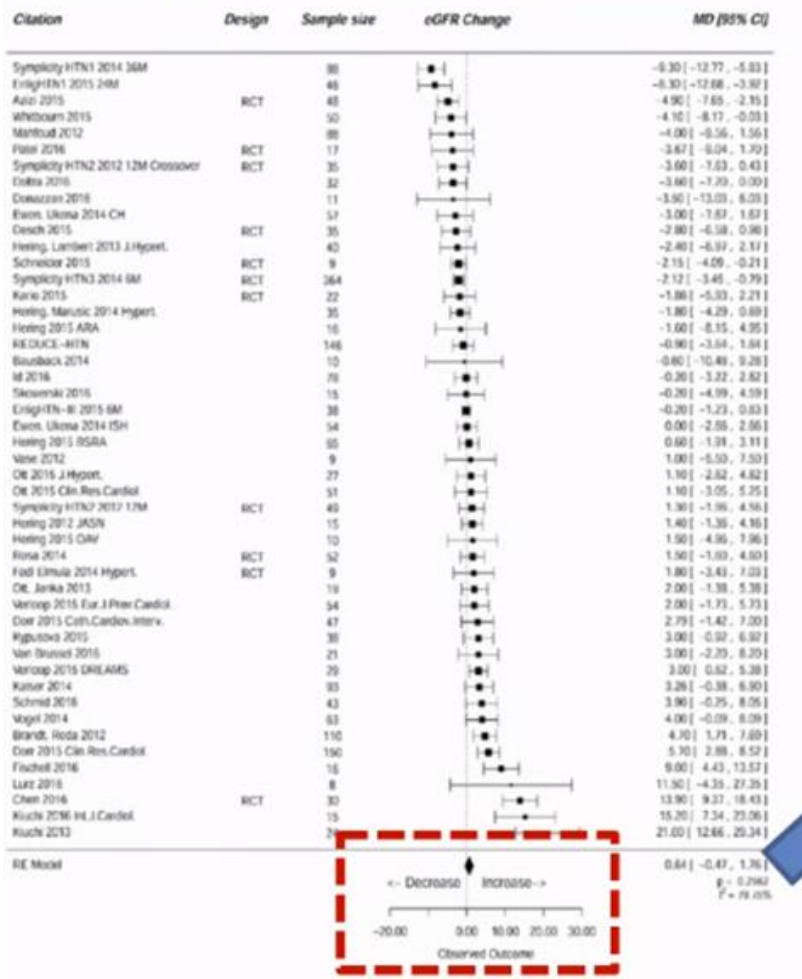
50 published renal denervation (RDN) trials
5,769 subjects with 10,249 patient-years of follow-up

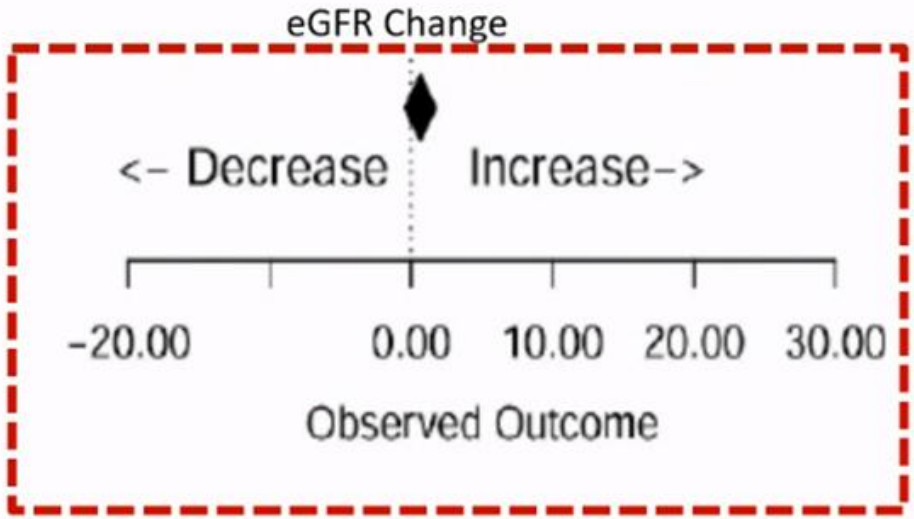
- 26 patients with renal artery stenosis or dissection (0.45%)
- 24 patients(0.41%) renal artery stenting.
- 0.20% pooled annual incidence rate of stent implantation (95% CI: 0.12 to 0.29% per year).
- Median time of occurence: 5.5 months (0 to 33 months)
- 79% of events occurred within one year of RDN
- Follow-up imaging in 511 subjects : 1 new significant RAS (0.20%) after a median of 11 months post RND

Townsend RR et al. EuroIntervention. 2020;16:89

Renal safety of RDN

Forest plot of 48 RDN cohorts, 2381 patients, with information on change in eGFRRenal





There was no statistically significant change in eGFR after a mean follow-up time of 9.1 ± 7.0 months [0.64 mL/min/1.73 m 2 (95% confidence interval -0.47 to 1.76), P = 0.26].

Sanders MA, *Nephrol Dial Transplant* (2017) 32: 1440–1447.

Renal denervation systems

Main indications (2022 ESC/EAPCI clinical consensus statement & 2023 ESH hypertension guidelines):
– Uncontrolled hypertension confirmed by ABPM
– ≥3 antihypertensives or <3 drugs, if treatment elicits serious side effects
– eGFR ≥40 ml/min/1.73 m^2

Centre qualifications:
– Multidisciplinary hypertension team including hypertension specialists & specifically trained interventionalists

FDA-approved systems:

Paradise (US, 7 Fr, CE-marked)

Symplicity Spyral (RF, 6 Fr, CE-marked)

Catheter systems under investigation:

Netrod (RF, 8 Fr, CE-marked)

Iberis (RF, 6 Fr, CE-marked)

SyMapCath (mapping & RF, 6-7 Fr, not CE-marked)

Peregrine (alcohol-mediated, 7 Fr, CE-marked)

Procedural considerations:
– Safe arterial access & closure (e.g., US-guided puncture, use of closure devices)
– Adequate analgesia & sedation
– Start treatment distally and then move proximally
– Standard operating procedures (SOPs) are needed for each device

Lauder L EuroIntervention. 2024 Apr 15;20(8):e467

Current RDN Catheter Systems in Sham-Controlled Trials

	Netrod (Shanghai Golden Leaf MedTec)	Multielectrode (6 electrodes), basket-shaped tip, 120 s per ablation cycle	Uncontrolled hypertension without medication: EuroNetrod (not yet recruiting; NCT06722651) Uncontrolled hypertension despite medication: Netrod RDN (n = 205)[62]
	Iberis second-generation (AngioCare)	Multielectrode (4 monopolar electrodes), helical design, over-the-wire catheter, 60 s per ablation cycle, 90-cm catheter length for transfemoral and 160 cm for transradial RDN	Uncontrolled hypertension despite medication: Iberis-HTN (n = 217)[61]
	SyMapCath I (SyMap)	Steerable monoelectrode stimulation and ablation catheter, stimulation time 20-120 s, 120 s per ablation cycle	Uncontrolled hypertension despite medication: SMART (n = 220)[87]
	TIVUS (SoniVie)	Unidirectional steerable or multidirectional, over-the-wire, 30 s per emission	Uncontrolled hypertension without medication: THRIVE (ongoing; NCT06559891)

Lauder L. JACC Cardiovasc Interv. 2025;18:1833

Who to treat?

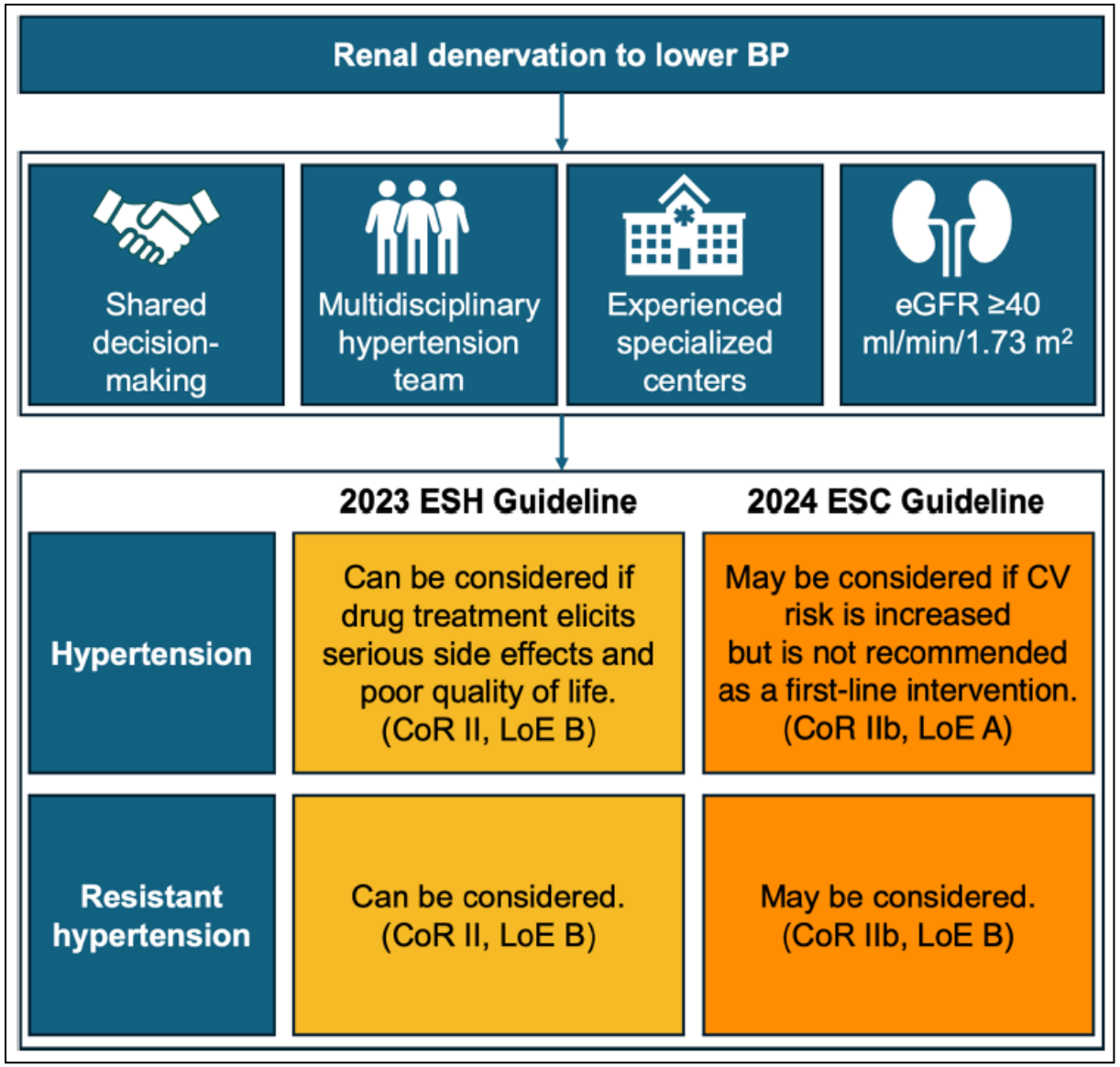
Indications of RDN in international guidelines or consensus statements

Indication	AHA 2025	ESC 2024	AHA 2024	ESH 2023
Uncontrolled hypertension		+	+	+*
Resistant hypertension	+	+	+	+
Intolerant to AHM	+		+	+
Non-adherent to AHM			+	
High CV risk / severe HMOD		+		

* Despite antihypertensive drug combination therapy

** BP >140 and 90 mm Hg despite despite taking ≥4 antihypertensive medications at optimal dosages (ACEi/ARB +CCB+thiazide-type diuretics, and MRA)

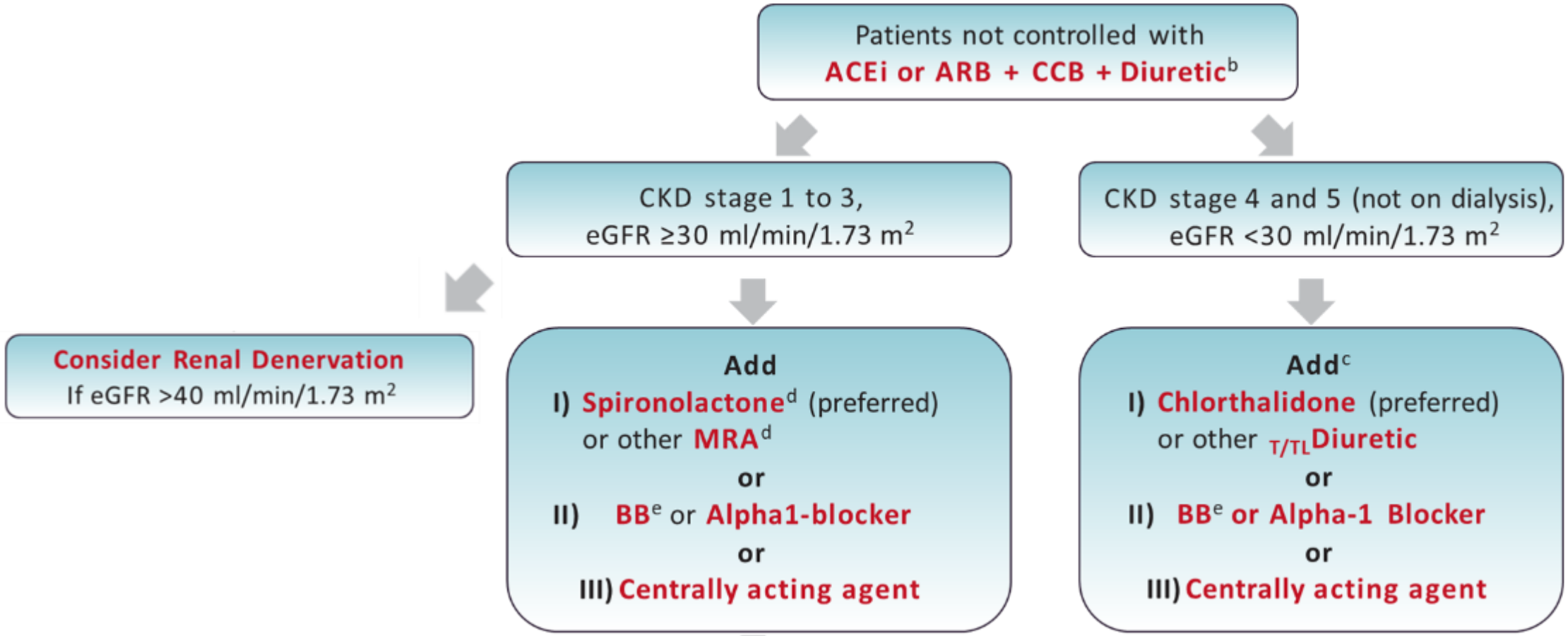
European Guideline Recommendations for RDN for the Treatment of Patients With Hypertension



Lauder L. JACC Cardiovasc Interv. 2025;18:1833

Summary

BP-lowering strategy in true resistant hypertension



Preprocedural imaging

1. **Non-invasive imaging : abdominal/pelvic CTA or MRA preferentially to duplex ultrasound**
   - presence of accessory arteries
   - anatomical ineligibility criteria
     - inappropriate vessel diameter/ early bifurcation
     - atherosclerotic renal artery stenosis ≥ 30%
     - renal artery stenting
     - FMD of renal arteries whatever the degree of stenosis
     - single functional or solitary kidney
     - transplanted kidney
     - extensive abdominal aortic calcifications
2. **Selective renal angiography immediately before RDN remains the gold standard since CTA or MRA may miss some renal artery abnormalities such as FMD.**

Endovascular interventionalists training and center eligibility

1. **The interventionalist cardiologists/radiologists**
   - should have expertise in access site management, in radiation protection and in specific aspects related to RDN and renal artery catheterization or stenting
   - should undergo specific training in RDN procedures in practical and/or simulated sessions, proctored sessions, RDN centre visits, hands-on with commercially available devices.

2. **Center eligibility for an RDN program**
   - Access to inpatient services
   - Access to imaging facilities, catheterization room,
   - Access to intensive care unit
   - Access to vascular surgery services
   - Access can be on site or remotely

Periprocedural management

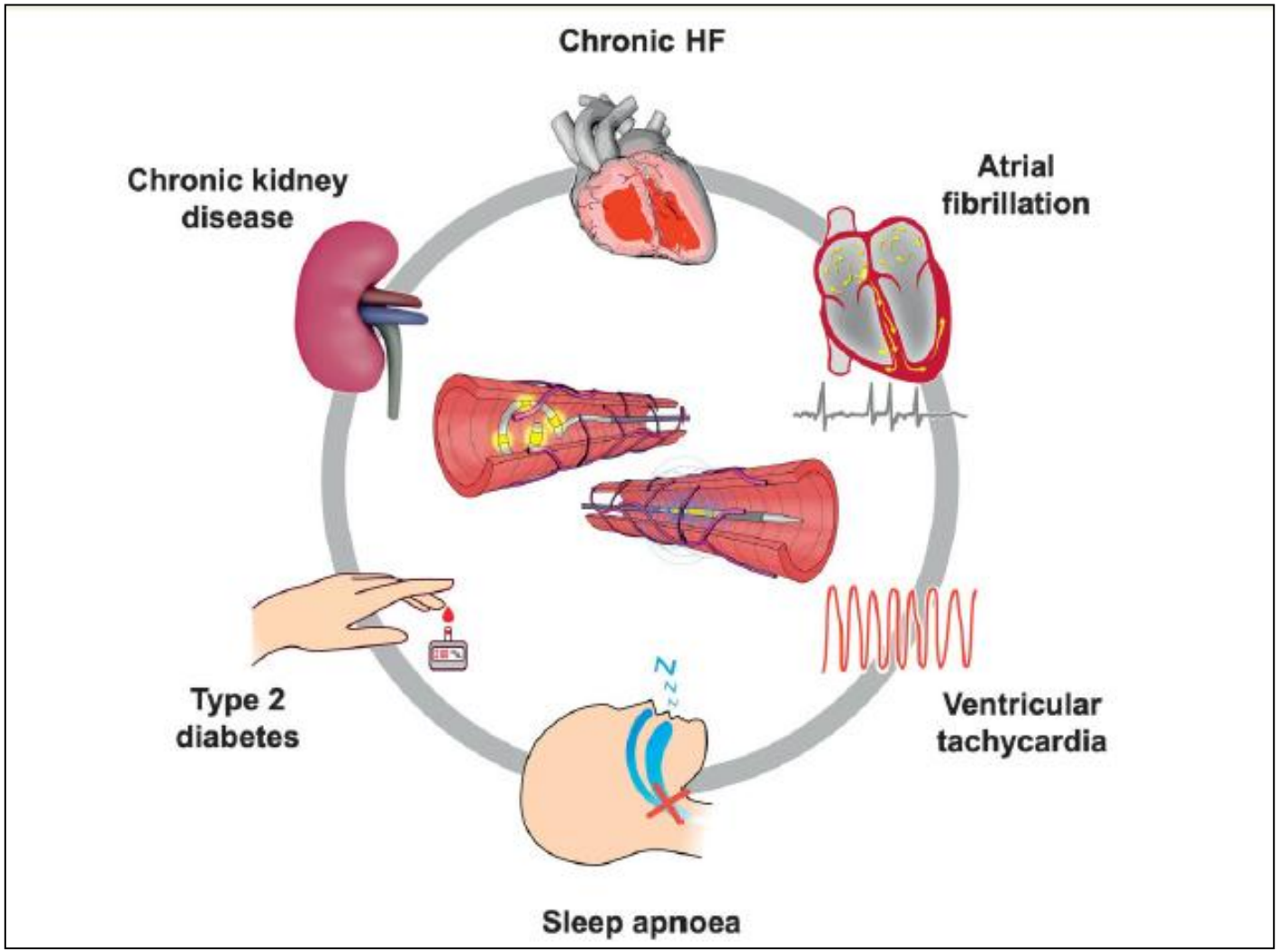
- Pre-anaesthesia consultation:
  - RDN is performed under sedation or short general anaesthesia because the procedure is painful.
- Anticoagulant treatments may be temporarily suspended based on the individual risk/benefit balance to limit bleeding complications related to the access site.
- The patient's antihypertensive medications are continued, including on the day of the intervention, unless there is an anaesthetic contraindication.

- The total duration of the procedure is approximately 1 hour and the patient is monitored until the following morning in the hospital.
- Risks of complications at the femoral access site may be minimized using US-guided arterial puncture and arterial closure systems at the end of the procedure
- Aspirin 75–100 mg/d may be given for 1 month after the procedure (low level of evidence)
- Outpatient intervention can be organized, provided clear follow-up instructions are provided to the patient

Follow-up after RDN

1. Optimization of antihypertensive medications after RDN and follow-up of the hypertensive disease.
2. Plasma creatinine can be measured within 30 days, depending on the pre-RDN eGFR and the amount of contrast media injected during RDN.
3. Despite the rarity of renal complications, we suggest performing a renal CTA or Duplex US between 6 months and 1 year after RDN to detect the occurrence of *de novo* renal artery stenosis.
4. BP follow-up with out-of-office BP measurements (HBPM or ABPM) at least at 1–3, 6 and 12 months.
5. HBPM allows the reduction of antihypertensive medication if there is a large decrease in BP and the optimization of therapy in case of persistent uncontrolled BP.

Potential indications of RDN beyond hypertension



Patient considerations and Themes Across Consensus Statements

Universal Patient Consideration themes across Statements

Elevated BP

Blood pressure (BP) uncontrolled despite attempted hypertensive medications

Merci pour votre attention!