

# Hypertension and Chronic Kidney Disease... An Unhappy Marriage



Harvey A. Feldman, MD, FACP, FASN  
Professor, Physician Assistant Program  
Nova Southeastern University, Ft. Lauderdale, FL

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## Outline

- Epidemiology and the bidirectional pathophysiologic relationships between hypertension and CKD
- Hypertension phenotypes prevalent in CKD
- Key points in evaluation of hypertension in CKD
- Comorbidities associated with hypertension in CKD
- New 2021 KDIGO hypertension guideline for CKD  
Comparison with the 2017 ACC/AHA hypertension guideline

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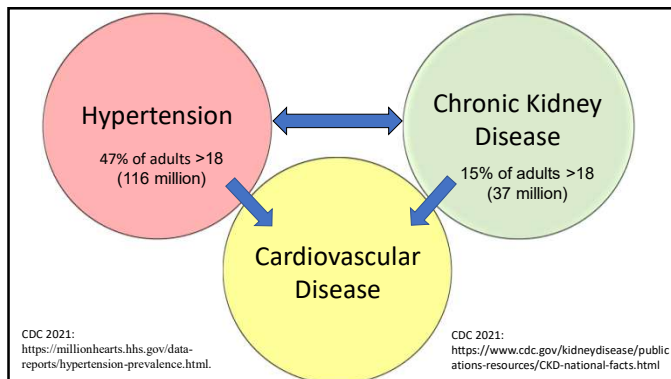
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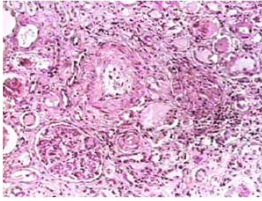
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


### Does Hypertension CAUSE Kidney Disease?

**Hypertensive Crisis**



**Malignant Nephrosclerosis**  
Fibrinoid necrosis and thrombosis in renal vessels, inflammation



- Clinically.....
  - Acute kidney injury
  - Hematuria
  - Proteinuria
  - Microangiopathic hemolytic anemia (schistocytes)

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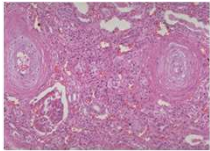
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### Does Hypertension CAUSE Kidney Disease?

**Chronic Hypertension**



**Benign Nephrosclerosis**  
(hypertensive nephrosclerosis)  
Scarring of vessels (onion ringing), glomeruli, and interstitium, and tubular atrophy and dilation



- Clinically.....
  - Slowly rising creatinine (over many years)
  - Little or no proteinuria
  - Accounts for 25% of ESKD

**Problems.....**

- HTN is so common, a small percentage of patients at risk of ESKD = large number
- Kidney biopsies are rarely done to r/o other dxs
- African Americans with ESKD attributed to HTN may have ESKD due to the APOL1 gene variant
- Pathology and clinical phenotype are nonspecific

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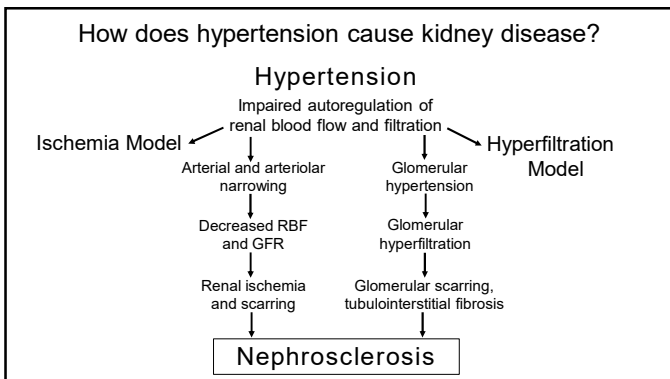
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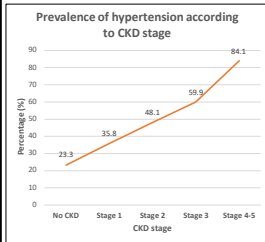
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### Does Kidney Disease CAUSE Hypertension?



CKD is a leading cause of secondary hypertension

- Prevalence of HTN increases with severity of CKD
- Albuminuria is a strong risk factor for HTN in CKD and correlates with poor BP control
- Black and Hispanic patients with CKD have the highest severity of HTN and are more likely to progress to ESKD

Tedla FM. Int J Hypertens 2011;13:2405.  
Johansen KL. Am J Kidney Dis 2021;77(4)(suppl 1):S1-S597. Agarwal R. Hypertens 2005;46:514-20.

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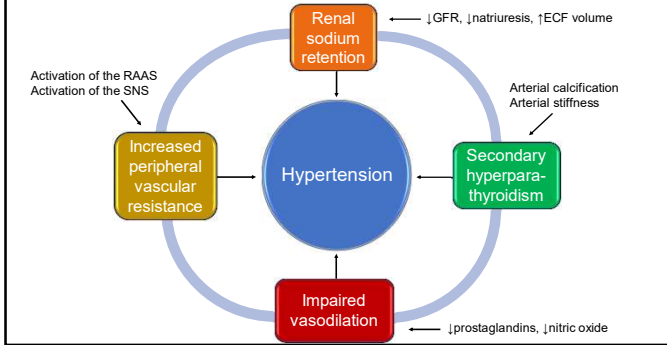
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### How does kidney disease cause hypertension?



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### Hypertension Phenotypes based on office and home or ambulatory BP

Untreated patients		Treated patients	
Normal office BP and Normal home or ABPM	High office BP but Normal home or ABPM	Normal office BP and Normal home or ABPM	High office BP but Normal home or ABPM
<b>Sustained normotension</b>	<b>White coat hypertension</b>	<b>True BP control</b>	<b>White coat effect (white coat uncontrolled HTN)</b>
High office BP and High home or ABPM	Normal office BP but High home or ABPM	High office BP and High home or ABPM	Normal office BP but High home or ABPM
<b>Sustained hypertension</b>	<b>Masked hypertension</b>	<b>True uncontrolled or resistant HTN</b>	<b>Masked uncontrolled hypertension or masked resistant HTN</b>

Patients with white coat hypertension or white coat effect tend to progress to sustained hypertension over time.

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### Hypertension Phenotypes more common in CKD than in the general population

Untreated patients		Treated patients	
Normal office BP and Normal home or ABPM <b>Sustained normotension</b>	High office BP but Normal home or ABPM <b>White coat hypertension</b>	Normal office BP and Normal home or ABPM <b>True BP control</b>	High office BP but Normal home or ABPM <b>White coat effect (white coat uncontrolled HTN)</b>
High office BP and High home or ABPM <b>Sustained hypertension</b>	Normal office BP but High home or ABPM <b>Masked hypertension</b>	High office BP and High home or ABPM <b>True uncontrolled or resistant HTN</b>	Normal office BP But High home or ABPM <b>Masked uncontrolled hypertension or masked resistant HTN</b>

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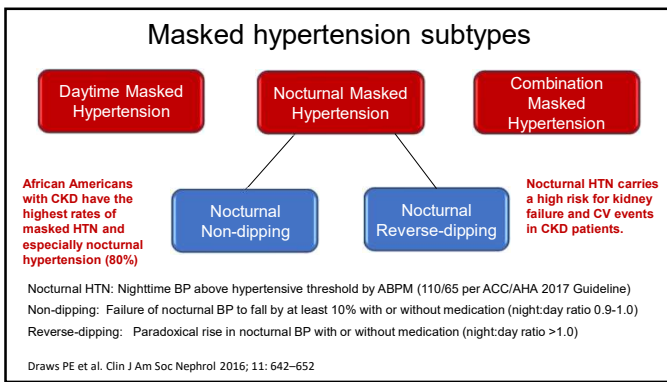
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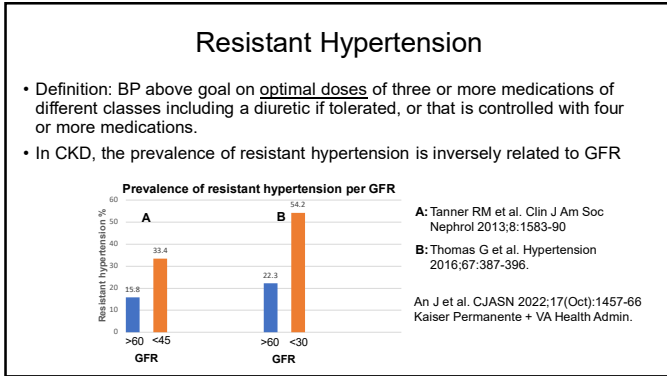
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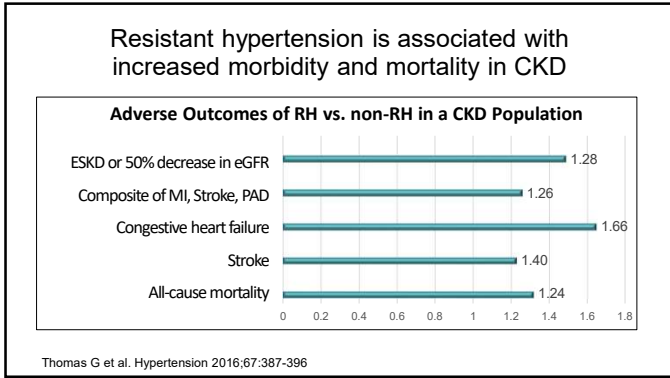
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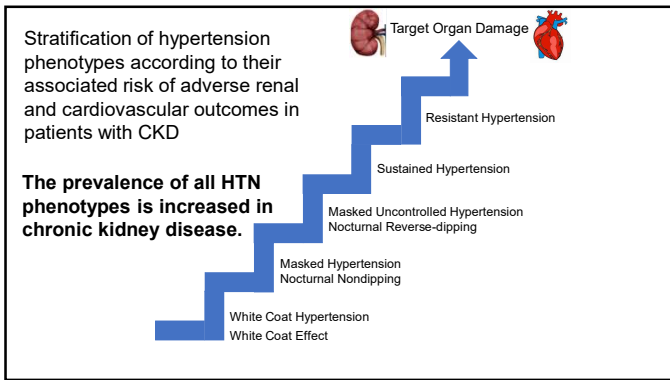
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### Standardized Blood Pressure Measurement is ESSENTIAL

ACC/AHA 2017 Hypertension Guideline

4.1. Accurate Measurement of BP in the Office

Recommendation for Accurate Measurement of BP in the Office		
COR	LOE	Recommendation
I	C, EO	1. For diagnosis and management of high BP, proper methods are recommended for accurate measurement and documentation of BP (Table 5).

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**Standardized Blood Pressure Measurement is ESSENTIAL**

- Do not talk or move before or during the reading.
- Sit upright with back supported.
- No caffeine, smoking, or exercise for 30+ minutes before first reading.
- Start readings after a 5-minute delay.
- Deflate at 2 mm Hg per second.
- Take 2-3 readings 1 minute apart.
- Arm bare and supported.
- Use a validated device. validatebp.org, stridebp.org, dableducational.org
- Proper cuff size.
- Cuff at heart level with lower edge 2-3 cm above elbow crease.
- Keep arm and hand relaxed.
- Empty bladder.
- Sit comfortably with feet on floor and legs uncrossed.

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**Automated Office Blood Pressure Device**

- Observer-free; starts automatically after 5-minute delay
- Takes 3 readings 1-minute apart
- Averages the 3 readings

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**Improper technique can raise BP levels**

Cuff size too small	→	2-10 mm Hg
Cuff over clothing	→	5-50 mm Hg
Arm unsupported or dependent	→	10-15 mm Hg
Unsupported back and feet	→	6 mm Hg
Legs crossed	→	2-8 mm Hg
Talking or active listening	→	10 mm Hg
Full bladder	→	10 mm Hg

Data from AHA/AMA TARGET:BP (targetbp.org)

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Adherence to proper technique is uncommon in primary care practice

26 primary care practices in Geneva, Switzerland  
 Mean difference in BP between PCP and research assistant after PCP training: 23 mm Hg SBP and 14 mm Hg DBP

• Common errors

Back unsupported	50%
Arm unsupported	64%
Center of cuff not over brachial artery	52%
Single blood pressure reading	83%

Sebo P et al. J Hypertension 2014;509-517

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Why is standardized measurement essential?

• All clinical trials on which current guideline BP targets are based used **standardized office BP measurements**.

Clinical Trial	Method	Rest (minutes)	# of readings
SPRINT	AOBP	5	3
SPS3	AOBP	15	3
ADVANCE	AOBP	5	2
ACCORD	AOBP	5	3
ONTARGET	AOBP	3	2
AASK	Manual	5	3
MDRD	Manual	5	3

AOBP = Automated Office Blood Pressure measurements

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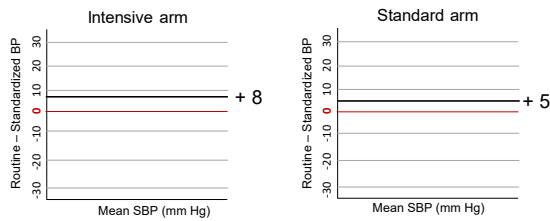
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Comparison of routine office BPs and standardized BPs in SPRINT



Drawz PF et al. JAMA Intern Med. 2020;180(12):1655-1663

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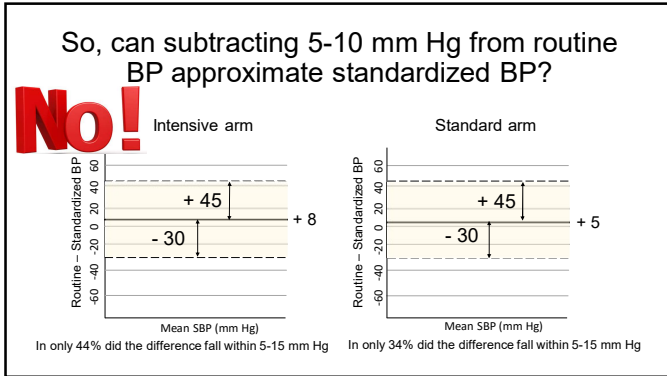
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The hazards of routine BP measurements

- Hazards of over-treatment of hypertension
  - Postural hypotension → debilitating symptoms
  - Recurrent falls and fractures
  - Stroke in patients with carotid obstructive disease
  - Acute kidney injury, esp. in those with renovascular disease
- Hazards of under-treatment of hypertension
  - Uncontrolled hypertension
  - Ischemic heart disease
  - Heart failure
  - Chronic kidney disease

**Remember:** CKD patients are at the highest risk for adverse CV outcomes.  
 ∴ They stand to benefit the most from accurate BP measurements.

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But ....Are standardized BP measurements feasible in a primary care practice?

- Equipment
  - AOBP devices can free up staff and provider time
  - Proper cuff sizes available (>40% of patients need a large cuff)
  - Upfront costs may pay off in the long-term
- Staff education
  - Train and re-train in proper BP technique
  - Stress importance of accurate BP measurements
- Workflow
  - Bring patients in 15 minutes before visit
  - Have patients fill out medical information ahead of visit
- Patient education
  - Wear clothing that allows arm to be exposed
  - Don't smoke, exercise, drink caffeine 30 minutes before visit.
  - Empty bladder before entering exam room

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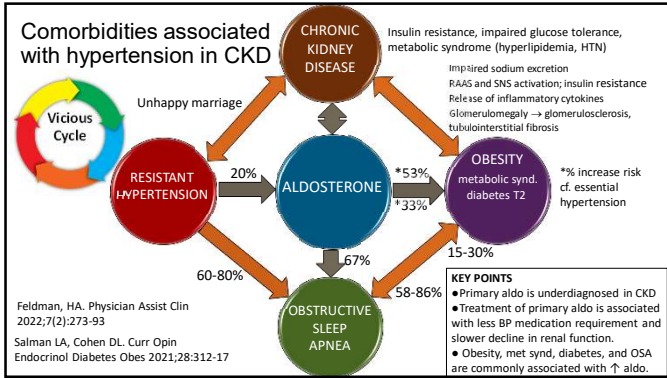
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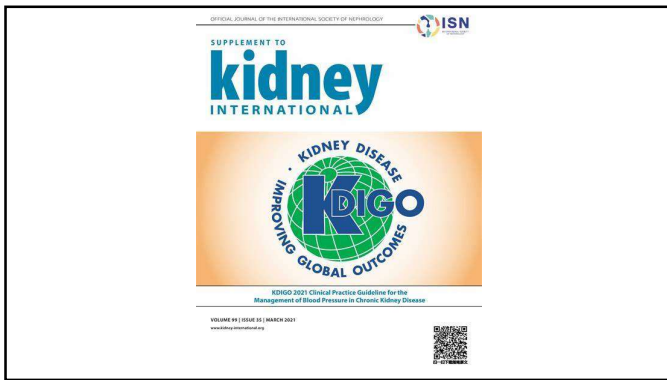
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**KDIGO Recommendation for Blood Pressure Target**

Recommendation 3.1.1.  
 “We suggest that adults with CKD and high BP be treated with a **target systolic blood pressure (SBP) of less than 120 mm Hg** using standardized office BP measurement (2B).”

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KDIGO Recommendation for Blood Pressure Target

Recommendation 3.1.1.

"We suggest that adults with CKD and high BP be treated with a target systolic blood pressure (SBP) of less than 120 mm Hg using standardized office BP measurement (2B)."

2 = weak recommendation  
B = moderate quality of evidence

Based on a subset of participants in a single RCT (SPRINT)

Uncertain benefit in CKD patients excluded from SPRINT:

- Diabetes, GFR <30 ml/min, SBP <130 mm Hg or >180 mm Hg,
- very low DBP, age ≥85, very frail or institutionalized, proteinuria >1g/day

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KDIGO vs. ACC/AHA



ACC/AHA: "Adults with hypertension and CKD should be treated to a BP goal of less than 130/80 mm Hg (1B)."

The SBP target (<130 mm Hg) is higher than in SPRINT because:

- Entry criteria in RCTs limit extrapolation to a more general population.
- Standardized BP measurements in RCTs are lower than in clinical practice.

KDIGO: "We suggest that adults with CKD and high BP be treated with a target systolic blood pressure (SBP) of less than 120 mm Hg using standardized office BP measurement (2B)."

- There are no outcomes trials supporting a target of <130 mm Hg.
- Patients should not be penalized for suboptimal clinical practice.

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KDIGO Recommendation for Blood Pressure Target

Recommendation 3.1.1:

"We suggest that adults with CKD and high BP be treated with a target systolic blood pressure (SBP) of less than 120 mm Hg using standardized office BP measurement (2B)."

Practice Point 3.1.1:

"It is potentially hazardous to apply the recommended SBP target of less than 120 mm Hg to BP measurements obtained in a non-standardized manner."

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Differences between ACC/AHA and KDIGO Guidelines for Patients with CKD		
	ACC/AHA 2017	KDIGO 2021
Definition of hypertension	≥130/≥80	"High BP" is defined as a BP above target.
BP threshold for drug intervention	130/80 (with lifestyle modifications)	BP above target (with lifestyle modifications)
BP target	<130/<80 Deviates from SPRINT SBP <120 to prevent hypotension if casual BP measurements are used	SBP <120 (no DBP target) Adheres strictly to SPRINT based on obligatory use of standardized BP measurements
Out of office BP (HBPM or ABPM)	Strong recommendation to confirm the diagnosis of hypertension and for titration of BP lowering medication	Weaker recommendation: use HBPM or ABPM to "complement" standardized office BP readings for the management of high BP*

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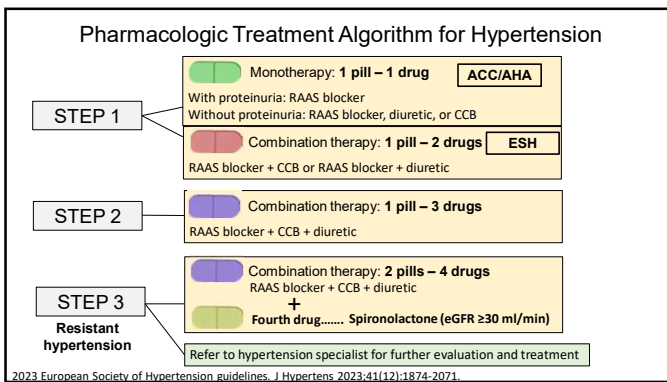
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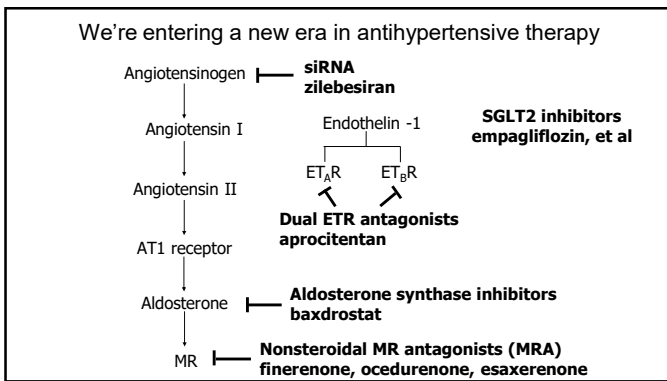
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