

# 2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults

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*GUIDELINES MADE SIMPLE*

*A Selection of Tables and Figures*



AMERICAN  
COLLEGE *of*  
CARDIOLOGY®

# 2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults

A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

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The ACC and AHA convened this writing committee to address the prevention, detection, evaluation, and management of high blood pressure in adults. The first comprehensive guideline for detection, evaluation, and management of high BP was published in 1977, under the sponsorship of the NHLBI. In subsequent years, a series of Joint National Committee (JNC) BP guidelines were published to assist the practice community and improve prevention, awareness, treatment, and control of high BP. The present guideline updates prior JNC reports.

The following resource contains Figures and Tables from the 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. The resource is only an excerpt from the Guideline and the full publication should be reviewed for more figures and tables as well as important context.

# 2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults

GUIDELINES MADE SIMPLE

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### Categories of BP in Adults\*

BP Category	SBP		DBP
<b>Normal</b>	<120 mm Hg	and	<80 mm Hg
<b>Elevated</b>	120–129 mm Hg	and	<80 mm Hg
<b>Hypertension</b>			
Stage 1	130–139 mm Hg	or	80–89 mm Hg
Stage 2	≥140 mm Hg	or	≥90 mm Hg

\*Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.

Table 6

### Corresponding Values of Systolic BP/Diastolic BP for Clinic, Home (HBPM), Daytime, Nighttime, and 24-Hour Ambulatory (ABPM) Measurements.

Clinic	HBPM	Daytime ABPM	Nighttime ABPM	24-Hour ABPM
120/80	120/80	120/80	100/65	115/75
130/80	130/80	130/80	110/65	125/75
140/90	135/85	135/85	120/70	130/80
160/100	145/90	145/90	140/85	145/90

Table 11

## Detection of White Coat Hypertension or Masked Hypertension in Patients Not on Drug Therapy

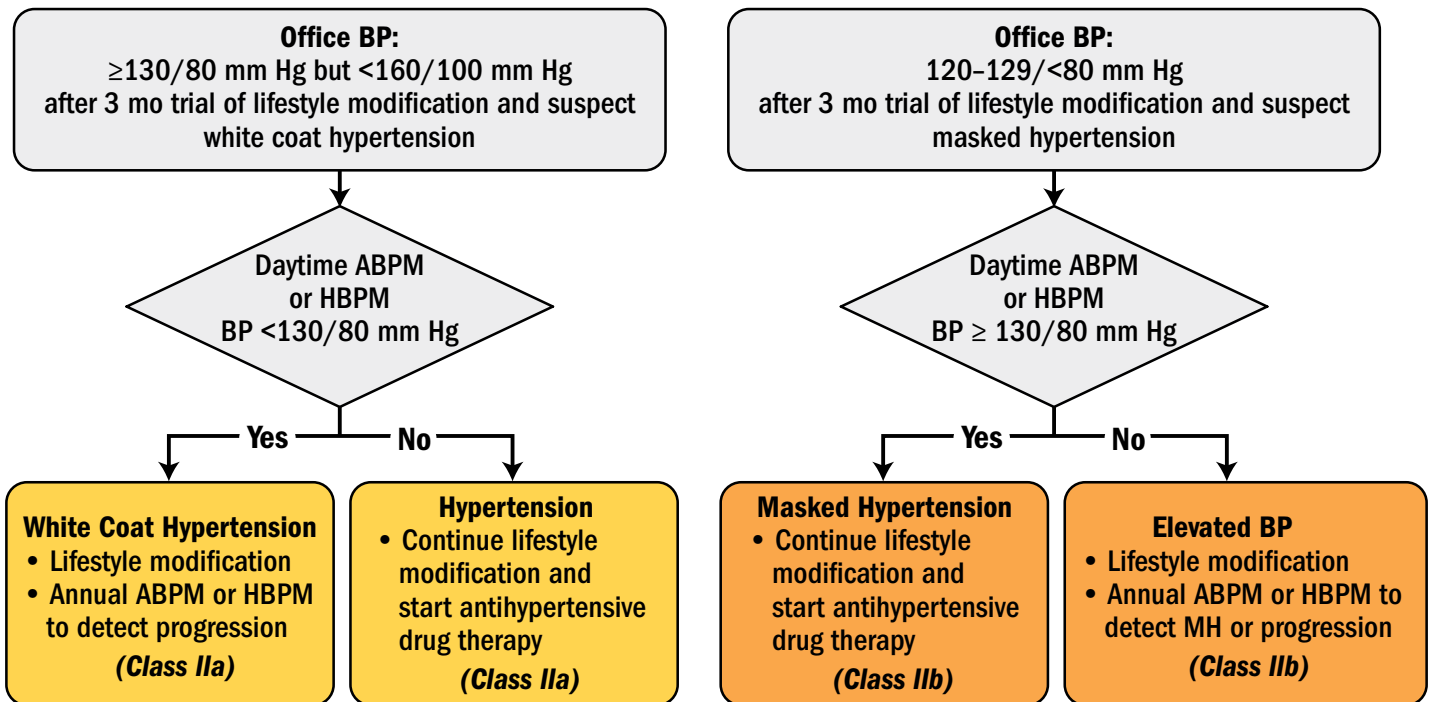


Figure 1

## Detection of White Coat Hypertension or Masked Hypertension in Patients on Drug Therapy

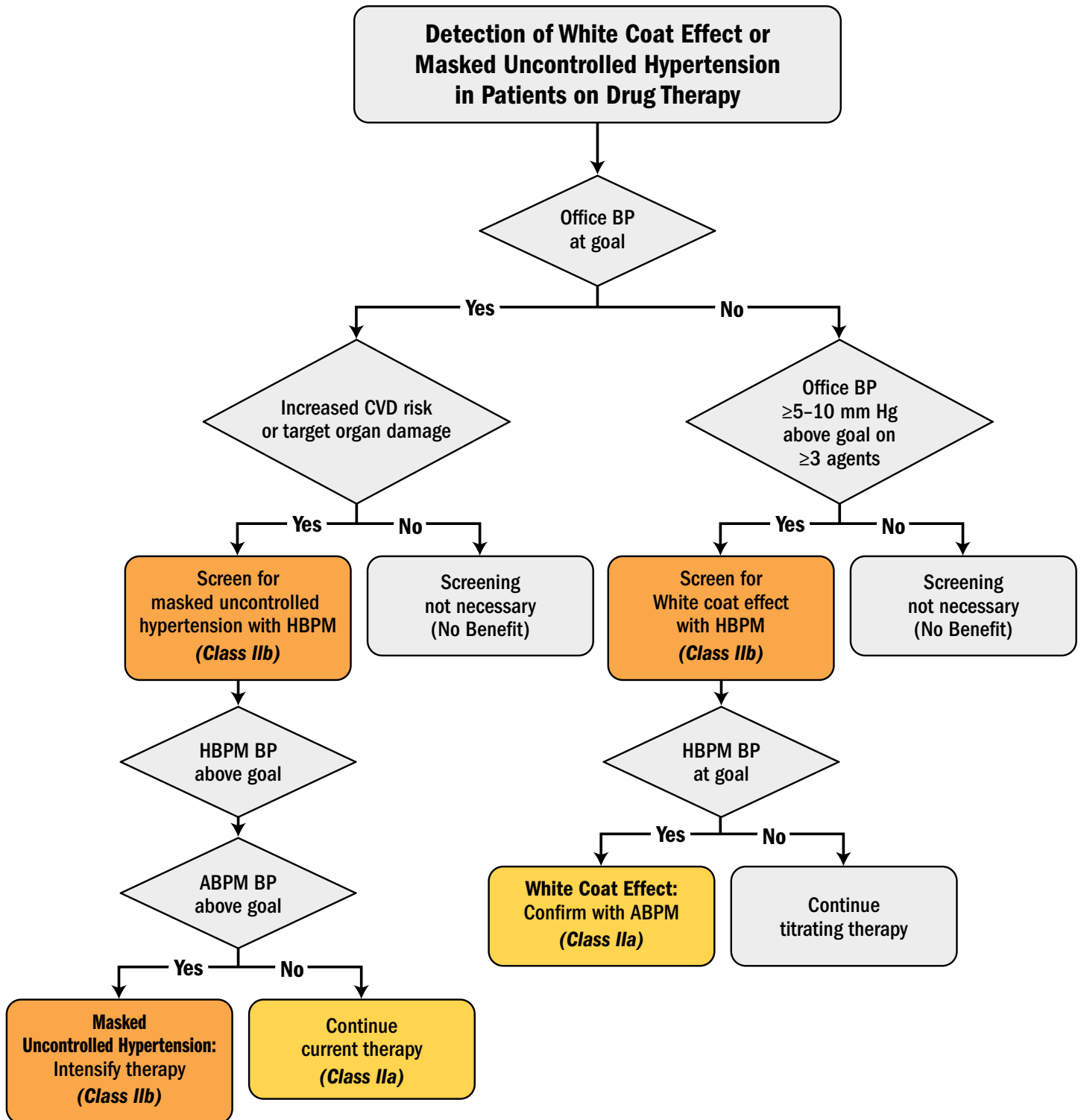


Figure 2

## Screening for Secondary Hypertension

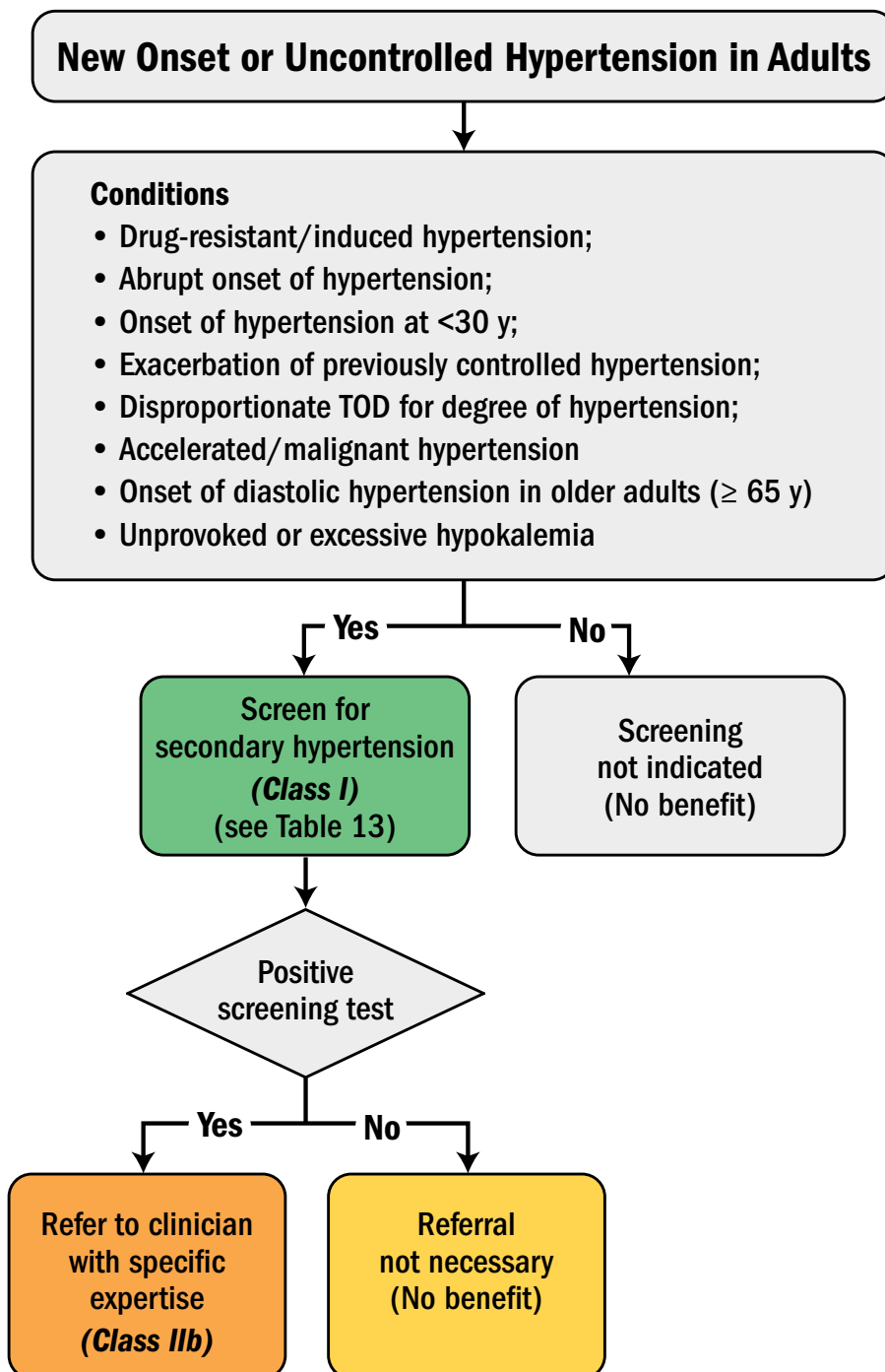


Figure 3



## Causes of Secondary Hypertension with Clinical Indications and Diagnostic Screening Tests (1 of 3)

	Prevalence	Clinical Indications	Physical Exam	Screening Tests	Additional/Confirmatory Tests
<b>Common Causes</b>					
Renal parenchymal disease	1%–2%	Urinary tract infections; obstruction, hematuria; urinary frequency and nocturia; analgesic abuse; family history of polycystic kidney disease; elevated serum creatinine; abnormal urinalysis	Abdominal mass (polycystic kidney disease); skin pallor	Renal ultrasound	Tests to evaluate cause of renal disease
Renovascular disease	5%–34%*	Resistant hypertension; hypertension of abrupt onset or worsening or increasingly difficult to control; flash pulmonary edema (atherosclerotic); early onset hypertension, especially in women (fibromuscular hyperplasia)	Abdominal systolic-diastolic bruit; bruits over other arteries (carotid – atherosclerotic or fibromuscular dysplasia), femoral	Renal Duplex Doppler ultrasound; MRA; abdominal CT	Bilateral selective renal intraarterial angiography
Primary aldosteronism	8%–20%†	Resistant hypertension; hypertension with hypokalemia (spontaneous or diuretic-induced); hypertension and muscle cramps or weakness; hypertension and incidentally discovered adrenal mass; hypertension and obstructive sleep apnea; hypertension and family history of early onset hypertension or stroke	Arrhythmias (with hypokalemia); especially atrial fibrillation	Plasma aldosterone/renin ratio under standardized conditions (correction of hypokalemia and withdrawal of aldosterone antagonists for 4–6 wk)	Oral sodium loading test (prior to 24 h urine aldosterone) or IV saline infusion test with plasma aldosterone at 4 h of infusion. Adrenal CT scan, Adrenal vein sampling. Trial of mineralocorticoid receptor blockers§
Obstructive sleep apnea‡	25%–50%	Resistant hypertension; snoring; fitful sleep; breathing pauses during sleep; daytime sleepiness	Obesity, Mallampati class III–IV; loss of normal nocturnal BP fall	Berlin Questionnaire (8); Epworth Sleepiness Score (9); overnight oximetry	Polysomnography
Drug- or alcohol-induced <sup>  </sup>	2%–4%	Sodium-containing antacids; caffeine; nicotine (smoking); alcohol; NSAIDs; oral contraceptives; cyclosporine or tacrolimus; sympathomimetics (decongestants, anorectics); cocaine, amphetamines and other illicit drugs; neuro psychiatric agents; erythropoiesis stimulating agents; clonidine withdrawal; herbal agents (MaHuang, ephedra)	Fine tremor, tachycardia, sweating (cocaine, ephedrine, MAO inhibitors); acute abdominal pain (cocaine)	Urinary drug screen (illicit drugs)	Response to withdrawal of suspected agent

*Uncommon Causes will be listed in the next two pages*





## Causes of Secondary Hypertension with Clinical Indications and Diagnostic Screening Tests (2 of 3)

	Prevalence	Clinical Indications	Physical Exam	Screening Tests	Additional/Confirmatory Tests
<b>Uncommon Causes</b>					
Pheochromocytoma/paraganglioma	0.1%–0.6%	Resistant hypertension; paroxysmal hypertension or crisis superimposed on sustained hypertension; “spells”, BP lability, headache, sweating, palpitations, pallor; positive family history of pheochromocytoma/paraganglioma; adrenal incidentaloma	Skin stigmata of neurofibromatosis (café-au-lait spots; neurofibromas); orthostatic hypotension	24-h urinary fractionated metanephrines or plasma metanephrines under standard conditions (30' supine position with indwelling IV cannula)	CT or MRI scan of abdomen/pelvis
Cushing's syndrome	<0.1%	Rapid weight gain, especially with central distribution; proximal muscle weakness; depression; hyperglycemia	Central obesity, “moon” face, dorsal and supraclavicular fat pads, wide (1 cm) violaceous striae, hirsutism	Overnight 1 mg dexamethasone suppression test	24-h urinary free cortisol excretion (preferably multiple); midnight salivary cortisol
Hypothyroidism	<1%	Dry skin; cold intolerance; constipation; hoarseness; weight gain	Delayed ankle reflex; periorbital puffiness; coarse skin; cold skin; slow movement; goiter	Thyroid stimulating hormone; free thyroxine	None
Hyperthyroidism	<1%	Warm, moist skin; heat intolerance; nervousness; tremulousness; insomnia; weight loss; diarrhea; proximal muscle weakness	Lid lag; fine tremor of the outstretched hands; warm, moist skin	Thyroid stimulating hormone, free thyroxine	Radioactive iodine uptake and scan
Aortic coarctation (undiagnosed or repaired)	0.1%	Young patient with hypertension (<30 y of age)	BP higher in upper extremities compared to lower extremities; absent femoral pulses; continuous murmur over patient's back, chest, or abdominal bruit; left thoracotomy scar (postoperative)	Echocardiogram	Thoracic and abdominal CT or MRA
Primary hyperparathyroidism	Rare	Hypercalcemia	Usually none	Serum calcium	Serum parathyroid hormone

*Uncommon Causes will continue in the next page*



## Causes of Secondary Hypertension with Clinical Indications and Diagnostic Screening Tests (3 of 3)

	Prevalence	Clinical Indications	Physical Exam	Screening Tests	Additional/Confirmatory Tests
<b>Uncommon Causes</b> (continued from previous page)					
Congenital adrenal hyperplasia	Rare	Hypertension and hypokalemia; virilization (11-beta-hydroxylase deficiency [11-beta-OH]) incomplete masculinization in males and primary amenorrhea in females (17-alpha-hydroxylase deficiency [17-alpha-OH])	Signs of virilization (11-beta-OH) or incomplete masculinization (17-alpha-OH)	Hypertension and hypokalemia with low or normal aldosterone and renin	11-beta-OH: elevated deoxycorticosterone (DOC), 11-deoxycortisol and androgens 17-alpha-OH: decreased androgens and estrogen; elevated deoxycorticosterone and corticosterone
Mineralocorticoid excess syndromes other than primary aldosteronism	Rare	Early onset hypertension; resistant hypertension; hypokalemia or hyperkalemia	Arrhythmias (with hypokalemia)	Low aldosterone and renin	Urinary cortisol metabolites; genetic testing
Acromegaly	Rare	Acral features, enlarging shoe, glove or hat size; headache, visual disturbances; diabetes mellitus	Acral features; large hands and feet; frontal bossing	Serum growth hormone $\geq 1$ ng/mL during oral glucose load	Elevated age- and sex-matched IGF-1 level; MRI scan of the pituitary

\*Depending on the clinical situation (hypertension alone, 5%; hypertension starting dialysis, 22%; hypertension and peripheral vascular disease, 28%; hypertension in the elderly with congestive heart failure, 34%).

†8% in general population with hypertension; up to 20% in patients with resistant hypertension.

‡Although obstructive sleep apnea is listed as a cause of secondary hypertension, RCTs on the effects of continuous positive airway pressure on lowering BP in patients with hypertension have produced mixed results

§May treat patients with resistant hypertension with a MRA whether or not primary aldosteronism is present.

Table 13



## Frequently Used Medications and Other Substances That May Cause Elevated BP\*

Agent	Possible Management Strategy
Alcohol	<ul style="list-style-type: none"> <li>Limit alcohol to <math>\leq 1</math> drink daily for women and <math>\leq 2</math> drinks for men</li> </ul>
Amphetamines (e.g., amphetamine, methylphenidate, dextromethylphenidate, dextroamphetamine)	<ul style="list-style-type: none"> <li>Discontinue or decrease dose</li> <li>Consider behavioral therapies for ADHD</li> </ul>
Antidepressants (e.g., MAOIs, SNRIs, TCAs)	<ul style="list-style-type: none"> <li>Consider alternative agents (e.g., SSRIs,) depending on indication</li> <li>Avoid tyramine containing foods with MAOIs</li> </ul>
Atypical antipsychotics (e.g., clozapine, olanzapine)	<ul style="list-style-type: none"> <li>Discontinue or limit use when possible</li> <li>Consider behavior therapy where appropriate</li> <li>Lifestyle modification (Section 6.2)</li> <li>Consider alternative agents associated with lower risk of weight gain, diabetes mellitus, and dyslipidemia (e.g., aripiprazole, ziprasidone).</li> </ul>
Caffeine	<ul style="list-style-type: none"> <li>Generally limit caffeine intake to <math>&lt; 300</math> mg/d</li> <li>Avoid use in patients with uncontrolled hypertension</li> <li>Coffee use in patients with hypertension associated with acute increases in BP; long-term use not associated with increased BP or CVD</li> </ul>
Decongestants (e.g., phenylephrine, pseudoephedrine)	<ul style="list-style-type: none"> <li>Use for shortest duration possible and avoid in severe or uncontrolled hypertension</li> <li>Consider alternative therapies (e.g., nasal saline, intranasal corticosteroids, antihistamines) as appropriate</li> </ul>
Herbal supplements (e.g., Ma Huang [ephedra], St. John's wort [with MAO inhibitors, yohimbine])	<ul style="list-style-type: none"> <li>Avoid use</li> </ul>
Immunosuppressants (e.g., cyclosporine)	<ul style="list-style-type: none"> <li>Consider converting to tacrolimus, which may be associated with less effects on BP</li> </ul>
Oral contraceptives	<ul style="list-style-type: none"> <li>Use low-dose (e.g., 20–30 mcg ethinyl estradiol) agents or a progestin-only form of contraception and/or consider alternative forms of birth control where appropriate (e.g., barrier, abstinence, IUD)</li> <li>Avoid use in women with uncontrolled hypertension</li> </ul>
NSAIDs	<ul style="list-style-type: none"> <li>Avoid systemic NSAIDs when possible</li> <li>Consider alternative analgesics (e.g., acetaminophen, tramadol, topical NSAIDs,) depending on indication and risk</li> </ul>
Recreational drugs (e.g., “bath salts” [MDPV], cocaine, methamphetamine, etc.)	<ul style="list-style-type: none"> <li>Discontinue and/or avoid use</li> </ul>
Systemic corticosteroids (e.g., dexamethasone, fludrocortisone, methylprednisolone, prednisone, prednisolone)	<ul style="list-style-type: none"> <li>Avoid or limit use when possible</li> <li>Consider alternative modes of administration (e.g., inhaled, topical) when feasible</li> </ul>
Angiogenesis inhibitor (eg. bevacizumab) and tyrosine kinase inhibitors (eg. sunitinib, sorafenif)	<ul style="list-style-type: none"> <li>Initiate or intensify antihypertensive therapy</li> </ul>

\*List is not all-inclusive.

Table 14

## Best Proven Nonpharmacologic Interventions for Prevention and Treatment of Hypertension\*

	Nonpharmacologic Intervention	Dose	Approximate Impact on SBP	
			Hypertension	Normotension
<b>Weight loss</b>	Weight/body fat	Ideal body weight is best goal but at least 1 kg reduction in body weight for most adults who are overweight. Expect about 1 mm Hg for every 1 kg reduction in body weight.	-5 mm Hg	-2/3 mm Hg
<b>Healthy diet</b>	DASH dietary pattern	Diet rich in fruits, vegetables, whole grains, and low-fat dairy products with reduced content of saturated and trans fat	-11 mm Hg	-3 mm Hg
<b>Reduced intake of dietary sodium</b>	Dietary sodium	<1,500 mg/d is optimal goal but at least 1,000 mg/d reduction in most adults	-5/6 mm Hg	-2/3 mm Hg
<b>Enhanced intake of dietary potassium</b>	Dietary potassium	3,500–5,000 mg/d, preferably by consumption of a diet rich in potassium	-4/5 mm Hg	-2 mm Hg
<b>Physical activity</b>	Aerobic	<ul style="list-style-type: none"> <li>• 120–150 min/wk</li> <li>• 65%–75% heart rate reserve</li> </ul>	-5/8 mm Hg	-2/4 mm Hg
	Dynamic Resistance	<ul style="list-style-type: none"> <li>• 90–150 min/wk</li> <li>• 50%–80% 1 rep maximum</li> <li>• 6 exercises, 3 sets/exercise, 10 repetitions/set</li> </ul>	-4 mm Hg	-2 mm Hg
	Isometric Resistance	<ul style="list-style-type: none"> <li>• 4 x 2 min (hand grip), 1 min rest between exercises, 30%–40% maximum voluntary contraction, 3 sessions/wk</li> <li>• 8–10 wk</li> </ul>	-5 mm Hg	-4 mm Hg
<b>Moderation in alcohol intake</b>	Alcohol consumption	In individuals who drink alcohol, reduce alcohol <sup>†</sup> to: <ul style="list-style-type: none"> <li>• Men: ≤2 drinks daily</li> <li>• Women: ≤1 drink daily</li> </ul>	-4 mm Hg	-3 mm Hg

\*Type, dose, and expected impact on BP in adults with a normal BP and with hypertension.

†In the United States, one “standard” drink contains roughly 14 grams of pure alcohol, which is typically found in 12 ounces of regular beer (usually about 5% alcohol), 5 ounces of wine (usually about 12% alcohol) and 1.5 ounces of distilled spirits (usually about 40% alcohol).

Table 15



## Basic and Optional Laboratory Tests for Primary Hypertension

<b>Basic Testing</b>	Fasting blood glucose*
	Complete blood count
	Lipid profile
	Serum creatinine with eGFR*
	Serum sodium, potassium, calcium*
	Thyroid-stimulating hormone
	Urinalysis
	Electrocardiogram
<b>Optional Testing</b>	Echocardiogram
	Uric acid
	Urinary albumin to creatinine ratio

\* May be included in a comprehensive metabolic panel

Table 17



## Blood Pressure (BP) Thresholds and Recommendations for Treatment and Follow-Up

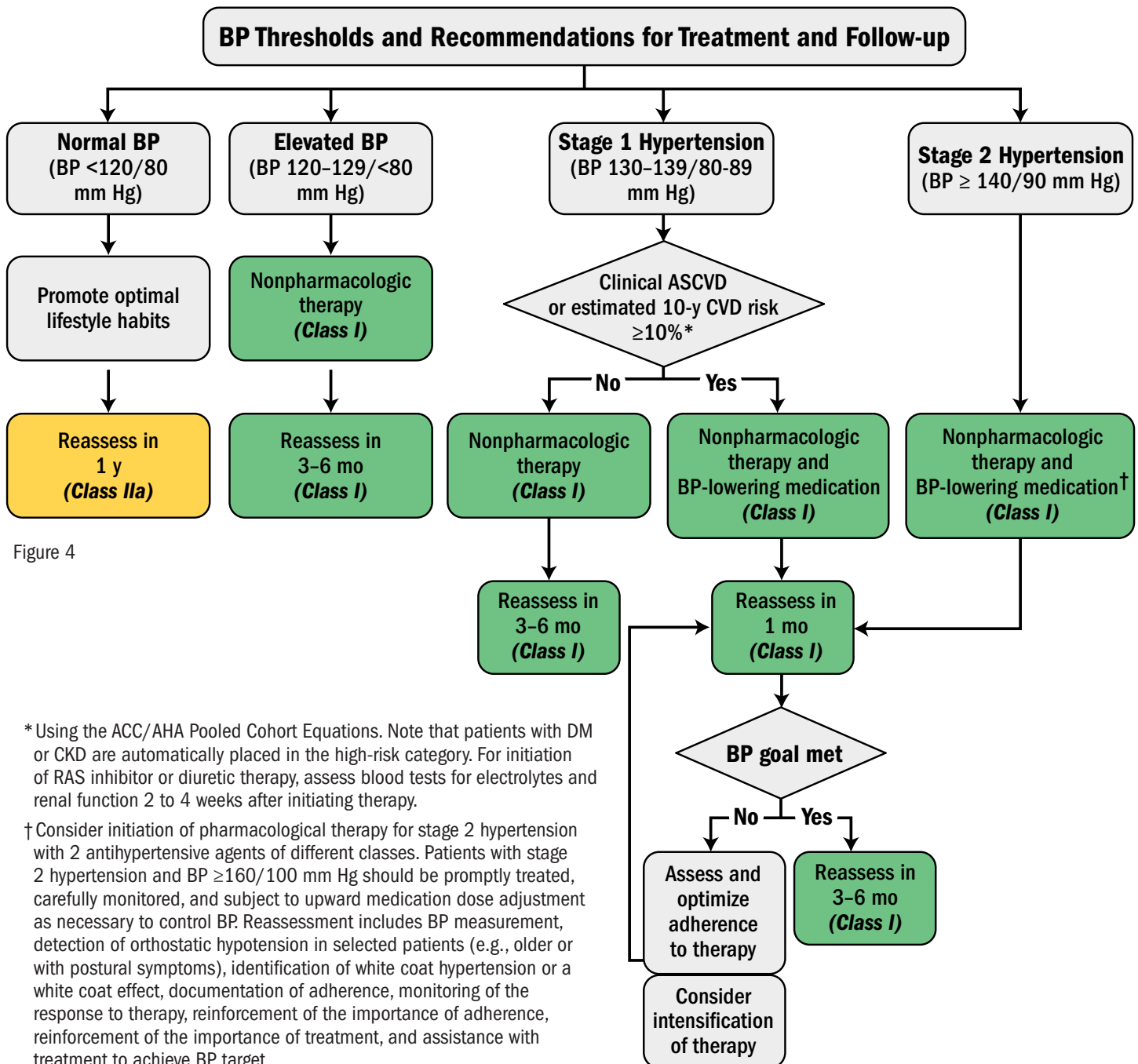


Figure 4

\*Using the ACC/AHA Pooled Cohort Equations. Note that patients with DM or CKD are automatically placed in the high-risk category. For initiation of RAS inhibitor or diuretic therapy, assess blood tests for electrolytes and renal function 2 to 4 weeks after initiating therapy.

†Consider initiation of pharmacological therapy for stage 2 hypertension with 2 antihypertensive agents of different classes. Patients with stage 2 hypertension and BP ≥160/100 mm Hg should be promptly treated, carefully monitored, and subject to upward medication dose adjustment as necessary to control BP. Reassessment includes BP measurement, detection of orthostatic hypotension in selected patients (e.g., older or with postural symptoms), identification of white coat hypertension or a white coat effect, documentation of adherence, monitoring of the response to therapy, reinforcement of the importance of adherence, reinforcement of the importance of treatment, and assistance with treatment to achieve BP target.

## BP Thresholds for and Goals of Pharmacologic Therapy in Patients with Hypertension According to Clinical Conditions

Clinical Condition (s)	BP Threshold mm Hg	BP Goal mm Hg
<b>General</b>		
Clinical CVD or 10 year ASCVD risk $\geq$ 10%	$\geq$ 130/80	<130/80
No clinical CVD and 10 year ASCVD risk <10%	$\geq$ 140/90	<130/80
Older persons ( $\geq$ 65 years of age; non-institutionalized, ambulatory, community-living adults)	$\geq$ 130 (SBP)	<130 (SBP)
<b>Specific Comorbidities</b>		
Diabetes mellitus	$\geq$ 130/80	<130/80
Chronic kidney disease	$\geq$ 130/80	<130/80
Chronic kidney disease post-renal transplantation	$\geq$ 130/80	<130/80
Heart failure	$\geq$ 130/80	<130/80
Stable ischemic heart disease	$\geq$ 130/80	<130/80
Secondary stroke prevention	$\geq$ 140/90	<130/80
Secondary stroke prevention (lacunar)	$\geq$ 130/80	<130/80
Peripheral arterial disease	$\geq$ 130/80	<130/80

Table 23



## GUIDELINES MADE SIMPLE

2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults

## Oral Antihypertensive Drugs (1 of 3)

Class	Drug	Usual Dose, Range (mg per day)*	Daily Frequency	Comments
<b>Primary Agents</b>				
Thiazide or thiazide-type diuretics	<b>Chlorthalidone</b>	12.5-25	1	<ul style="list-style-type: none"> <li>• Chlorthalidone preferred based on prolonged half-life and proven trial reduction of CVD</li> <li>• Monitor for hyponatremia and hypokalemia, uric acid and calcium levels.</li> <li>• Use with caution in patients with history of acute gout unless patient is on uric acid-lowering therapy.</li> </ul>
	<b>Hydrochlorothiazide</b>	25-50	1	
	<b>Indapamide</b>	1.25-2.5	1	
	<b>Metolazone</b>	2.5-10	1	
ACE Inhibitors	<b>Benazepril</b>	10-40	1 or 2	<ul style="list-style-type: none"> <li>• Do not use in combination with ARBs or direct renin inhibitor</li> <li>• Increased risk of hyperkalemia, especially in patients with CKD or in those on K+ supplements or K+-sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Do not use if history of angioedema with ACE inhibitors.</li> <li>• Avoid in pregnancy</li> </ul>
	<b>Captopril</b>	12.5-150	2 or 3	
	<b>Enalapril</b>	5-40	1 or 2	
	<b>Fosinopril</b>	10-40	1	
	<b>Lisinopril</b>	10-40	1	
	<b>Moexipril</b>	7.5-30	1 or 2	
	<b>Perindopril</b>	4-16	1	
	<b>Quinapril</b>	10-80	1 or 2	
	<b>Ramipril</b>	2.5-10	1 or 2	
ARBs	<b>Azilsartan</b>	40-80	1	<ul style="list-style-type: none"> <li>• Do not use in combination with ACE inhibitors or direct renin inhibitor</li> <li>• Increased risk of hyperkalemia in CKD or in those on K+ supplements or K+-sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Do not use if history of angioedema with ARBs. Patients with a history of angioedema with an ACEI can receive an ARB beginning 6 weeks after ACEI discontinued.</li> <li>• Avoid in pregnancy</li> </ul>
	<b>Candesartan</b>	8-32	1	
	<b>Eprosartan</b>	600-800	1 or 2	
	<b>Irbesartan</b>	150-300	1	
	<b>Losartan</b>	50-100	1 or 2	
	<b>Olmesartan</b>	20-40	1	
	<b>Telmisartan</b>	20-80	1	
	<b>Valsartan</b>	80-320	1	
CCB—dihydropyridines	<b>Amlodipine</b>	2.5-10	1	<ul style="list-style-type: none"> <li>• Avoid use in patients with HFrEF; amlodipine or felodipine may be used if required</li> <li>• Associated with dose-related pedal edema, which is more common in women than men</li> </ul>
	<b>Felodipine</b>	5-10	1	
	<b>Isradipine</b>	5-10	2	
	<b>Nicardipine SR</b>	5-20	1	
	<b>Nifedipine LA</b>	60-120	1	
	<b>Nisoldipine</b>	30-90	1	
CCB—nondihydropyridines	<b>Diltiazem SR</b>	180-360	2	<ul style="list-style-type: none"> <li>• Avoid routine use with beta blockers due to increased risk of bradycardia and heart block</li> <li>• Do not use in patients with HFrEF</li> <li>• Drug interactions with diltiazem and verapamil (CYP3A4 major substrate and moderate inhibitor)</li> </ul>
	<b>Diltiazem ER</b>	120-480	1	
	<b>Verapamil IR</b>	40-80	3	
	<b>Verapamil SR</b>	120-480	1 or 2	
	<b>Verapamil-delayed onset ER (various forms)</b>	100-480	1 (in the evening)	

Table is continued in the next two pages





## Oral Antihypertensive Drugs (2 of 3)

Class	Drug	Usual Dose, Range (mg per day)*	Daily Frequency	Comments
<b>Secondary Agents</b>				
Diuretics—loop	<b>Bumetanide</b>	0.5–4	2	<ul style="list-style-type: none"> <li>Preferred diuretics in patients with symptomatic HF. Preferred over thiazides in patients with moderate-to-severe CKD (e.g., GFR &lt;30 mL/min)</li> </ul>
	<b>Furosemide</b>	20–80	2	
	<b>Torsemide</b>	5–10	1	
Diuretics—potassium sparing	<b>Amiloride</b>	5–10	1 or 2	<ul style="list-style-type: none"> <li>Monotherapy agents minimally effective antihypertensives</li> <li>Combination therapy of potassium sparing diuretic with a thiazide can be considered in patients with hypokalemia on thiazide monotherapy</li> <li>Avoid in patients with significant CKD (e.g., GFR &lt;45 mL/min)</li> </ul>
	<b>Triamterene</b>	50–100	1 or 2	
Diuretics—aldosterone antagonists	<b>Eplerenone</b>	50–100	12	<ul style="list-style-type: none"> <li>Preferred agents in primary aldosteronism and resistant hypertension</li> <li>Spironolactone associated with greater risk of gynecomastia and impotence compared to eplerenone</li> <li>Common add-on therapy in resistant hypertension</li> <li>Avoid use with K<sup>+</sup> supplements, other K<sup>+</sup>-sparing diuretics or significant renal dysfunction</li> <li>Eplerenone often requires twice daily dosing for adequate BP lowering</li> </ul>
	<b>Spironolactone</b>	25–100	1	
Beta blockers—cardioselective	<b>Atenolol</b>	25–100	12	<ul style="list-style-type: none"> <li>Beta blockers are not recommended as first-line agents unless the patient has IHD or HF</li> <li>Preferred in patients with bronchospastic airway disease requiring a beta blocker</li> <li>Bisoprolol and metoprolol succinate preferred in patients with HFrEF</li> <li>Avoid abrupt cessation</li> </ul>
	<b>Betaxolol</b>	5–20	1	
	<b>Bisoprolol</b>	2.5–10	1	
	<b>Metoprolol tartrate</b>	100–400	2	
	<b>Metoprolol succinate</b>	50–200	1	
Beta blockers—cardioselective and vasodilatory	<b>Nebivolol</b>	5–40	1	<ul style="list-style-type: none"> <li>Induces nitric oxide-induced vasodilation</li> <li>Avoid abrupt cessation</li> </ul>
Beta blockers—noncardioselective	<b>Nadolol</b>	40–120	1	<ul style="list-style-type: none"> <li>Avoid in patients with reactive airways disease</li> <li>Avoid abrupt cessation</li> </ul>
	<b>Propranolol IR</b>	160–480	2	
	<b>Propranolol LA</b>	80–320	1	
Beta blockers—intrinsic sympathomimetic activity	<b>Acebutolol</b>	200–800	2	<ul style="list-style-type: none"> <li>Generally avoid, especially in patients with IHD or HF</li> <li>Avoid abrupt cessation</li> </ul>
	<b>Carteolol</b>	2.5–10	1	
	<b>Penbutolol</b>	10–40	1	
	<b>Pindolol</b>	10–60	2	

*Table is continued in the next page*



## Oral Antihypertensive Drugs (3 of 3)

Class	Drug	Usual Dose, Range (mg per day)*	Daily Frequency	Comments
<b>Secondary Agents</b> (continued from previous page)				
Beta blockers—combined alpha- and beta-receptor	<b>Carvedilol</b>	12.5-50	2	<ul style="list-style-type: none"> <li>• Carvedilol preferred in patients with HFrEF</li> <li>• Avoid abrupt cessation</li> </ul>
	<b>Carvedilol phosphate</b>	20-80	1	
	<b>Labetalol</b>	200-800	2	
Direct renin inhibitor	<b>Aliskiren</b>	150-300	1	<ul style="list-style-type: none"> <li>• Do not use in combination with ACE inhibitors or ARBs</li> <li>• Aliskiren is very long acting</li> <li>• Increased risk of hyperkalemia in CKD or in those on K<sup>+</sup> supplements or K<sup>+</sup> sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Avoid in pregnancy</li> </ul>
Alpha-1 blockers	<b>Doxazosin</b>	1-8	1	<ul style="list-style-type: none"> <li>• Associated with orthostatic hypotension, especially in older adults</li> <li>• May consider as second-line agent in patients with concomitant BPH</li> </ul>
	<b>Prazosin</b>	2-20	2 or 3	
	<b>Terazosin</b>	1-20	1 or 2	
Central alpha1-agonist and other centrally acting drugs	<b>Clonidine oral</b>	0.1-0.8	2	<ul style="list-style-type: none"> <li>• Generally reserved as last-line due to significant CNS adverse effects, especially in older adults</li> <li>• Avoid abrupt discontinuation of clonidine, which may induce hypertensive crisis; clonidine must be tapered to avoid rebound hypertension</li> </ul>
	<b>Clonidine patch</b>	0.1-0.3	1 weekly	
	<b>Methyldopa</b>	250-1000	2	
	<b>Guanfacine</b>	0.5-2	1	
Direct vasodilators	<b>Hydralazine</b>	250-200	2 or 3	<ul style="list-style-type: none"> <li>• Associated with sodium and water retention and reflex tachycardia; use with a diuretic and bet a blocker</li> <li>• Hydralazine associated with drug-induced lupus-like syndrome at higher doses</li> <li>• Minoxidil associated with hirsutism and requires a loop diuretic. Can induce pericardial effusion</li> </ul>
	<b>Minoxidil</b>	5-100	1-3	

\*Dosages may vary from those listed in the FDA approved labeling (available at <http://dailymed.nlm.nih.gov/dailymed/index.cfm>).

Adapted with permission from Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003; 289:2560-72

Table 18

## Heart Failure with Reduced Ejection Fraction (HFrEF)

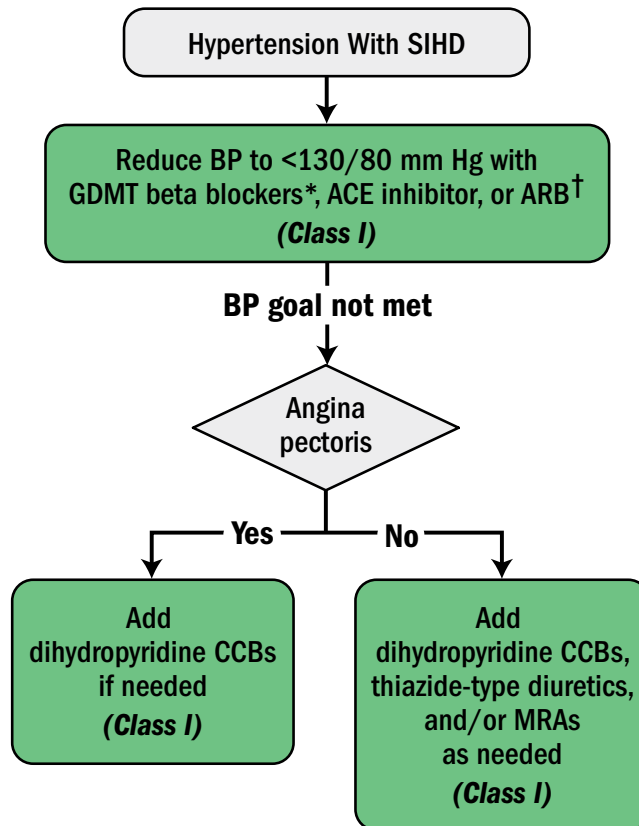
<b>Recommendations for Treatment of Hypertension in Patients with Heart Failure with Reduced Ejection Fraction (HFrEF)</b> Referenced studies that support recommendations are summarized in online Data Supplement 34		
COR	LOE	Recommendations
I	C-EO	1. Adults with HFrEF and hypertension should be prescribed GDMT* titrated to attain a BP less than 130/80 mm Hg.
III: No Benefit	B-R	2. Nondihydropyridine CCBs are not recommended in the treatment of hypertension in adults with HFrEF.

## Heart Failure with Preserved Ejection Fraction (HFpEF)

<b>Recommendations for Treatment of Hypertension in Patients with Heart Failure with Preserved Ejection Fraction (HFpEF)</b> Referenced studies that support recommendations are summarized in online Data Supplement 35, 36		
COR	LOE	Recommendations
I	C-EO	1. In adults with HFpEF who present with symptoms of volume overload, diuretics should be prescribed to control hypertension.
I	C-LD	2. Adults with HFpEF and persistent hypertension after management of volume overload should be prescribed ACE inhibitors or ARB and beta blockers titrated to attain systolic BP less than 130 mm Hg.



## Management of Hypertension in Patients with Stable Ischemic Heart Disease (SIHD)

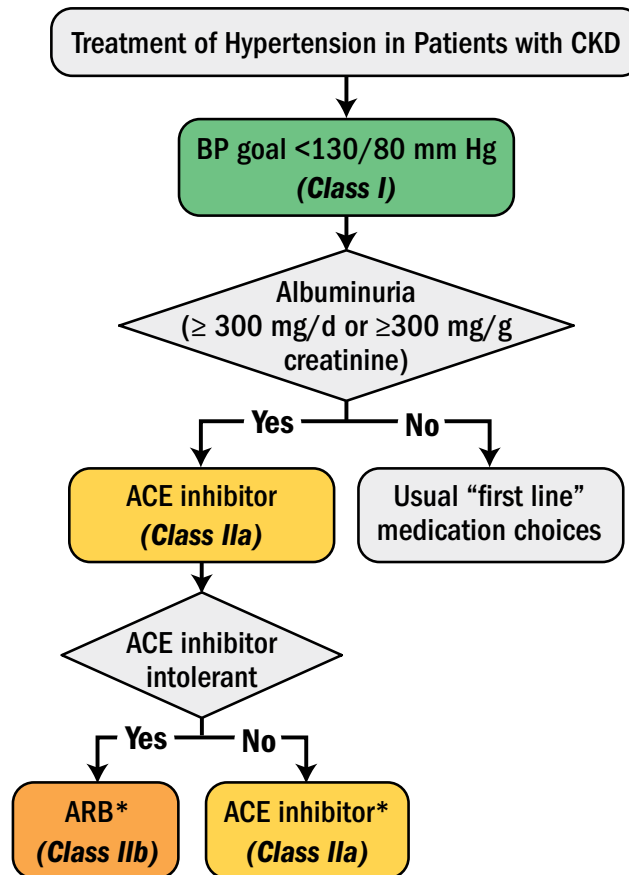


\* GDMT beta blockers for BP control or relief of angina include carvedilol, metoprolol tartrate, metoprolol succinate, nadolol, bisoprolol, propranolol, and timolol. Avoid beta blockers with intrinsic sympathomimetic activity. The beta blocker atenolol should not be used because it is less effective than placebo in reducing cardiovascular events.

† If needed for BP control.

Figure 5

## Management of Hypertension in Patients with Chronic Kidney Disease



\*CKD stage 3 or higher or stage 1 or 2 with albuminuria  $\geq 300$  mg/d or  $\geq 300$  mg/g creatinine.

Figure 6

## Management of Hypertension in Patients with Acute Intercerebral Hemorrhage

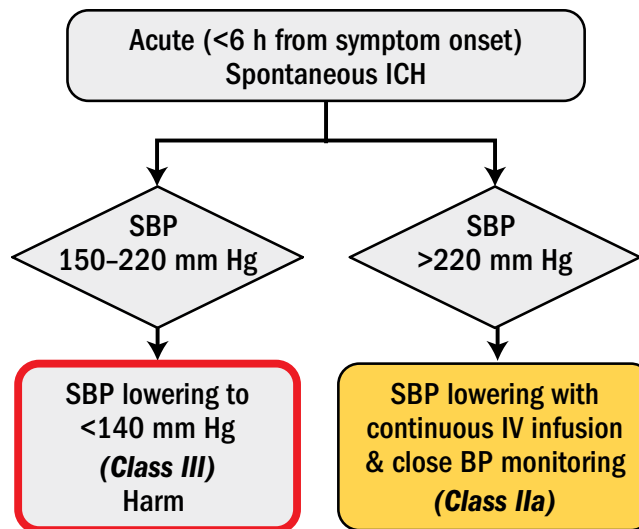


Figure 7

## Management of Hypertension in Patients with Acute ischemic Stroke

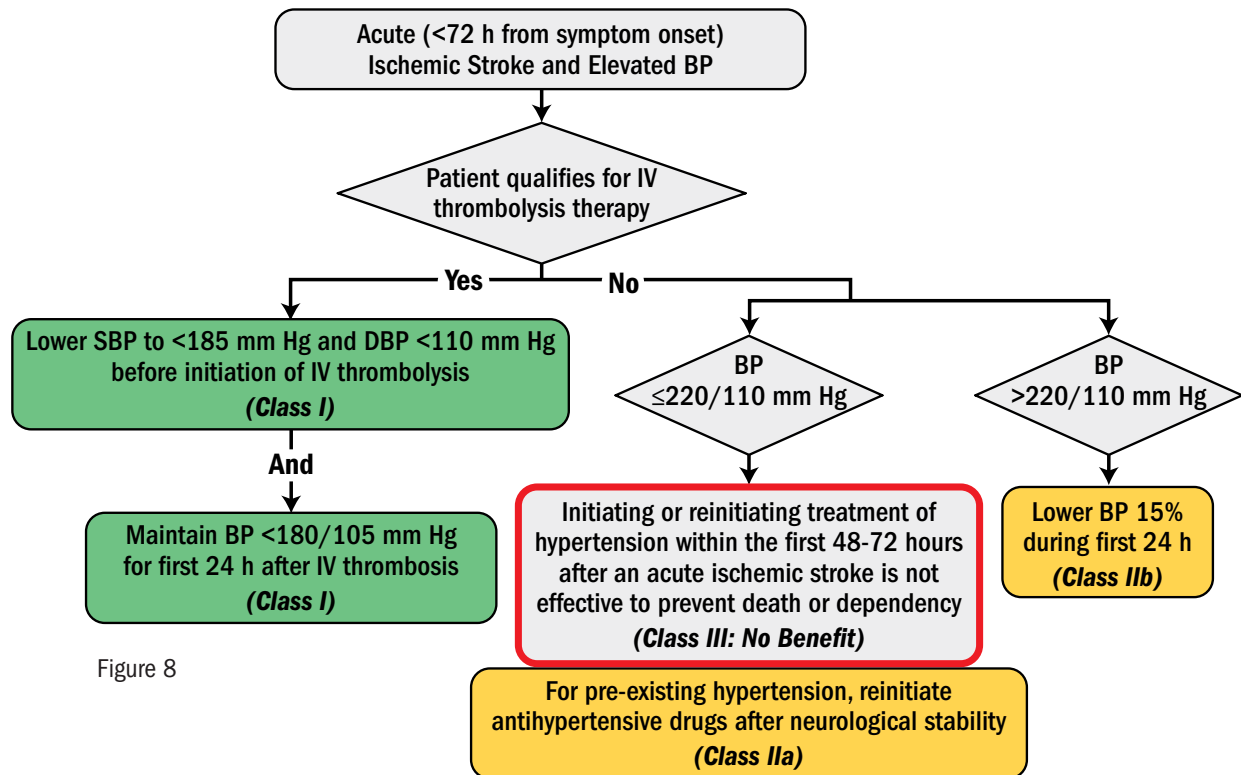


Figure 8

## Management of Hypertension in Patients with a Previous History of Stroke (Secondary Stroke Prevention)

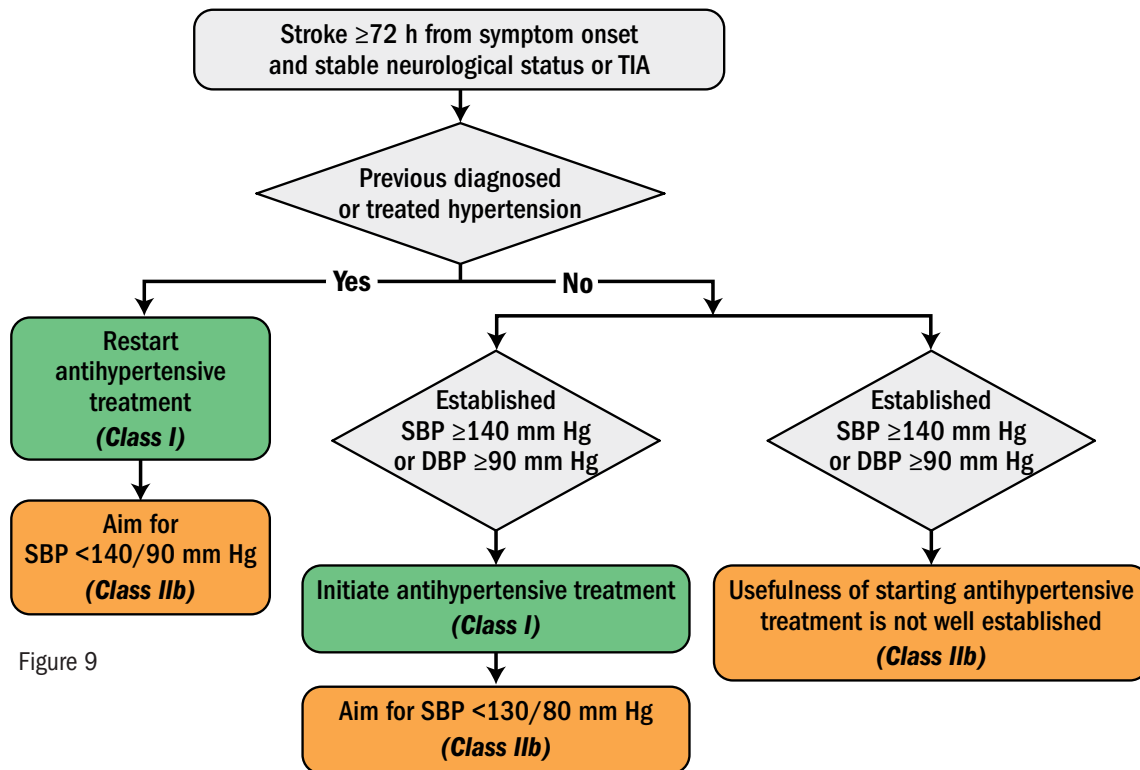
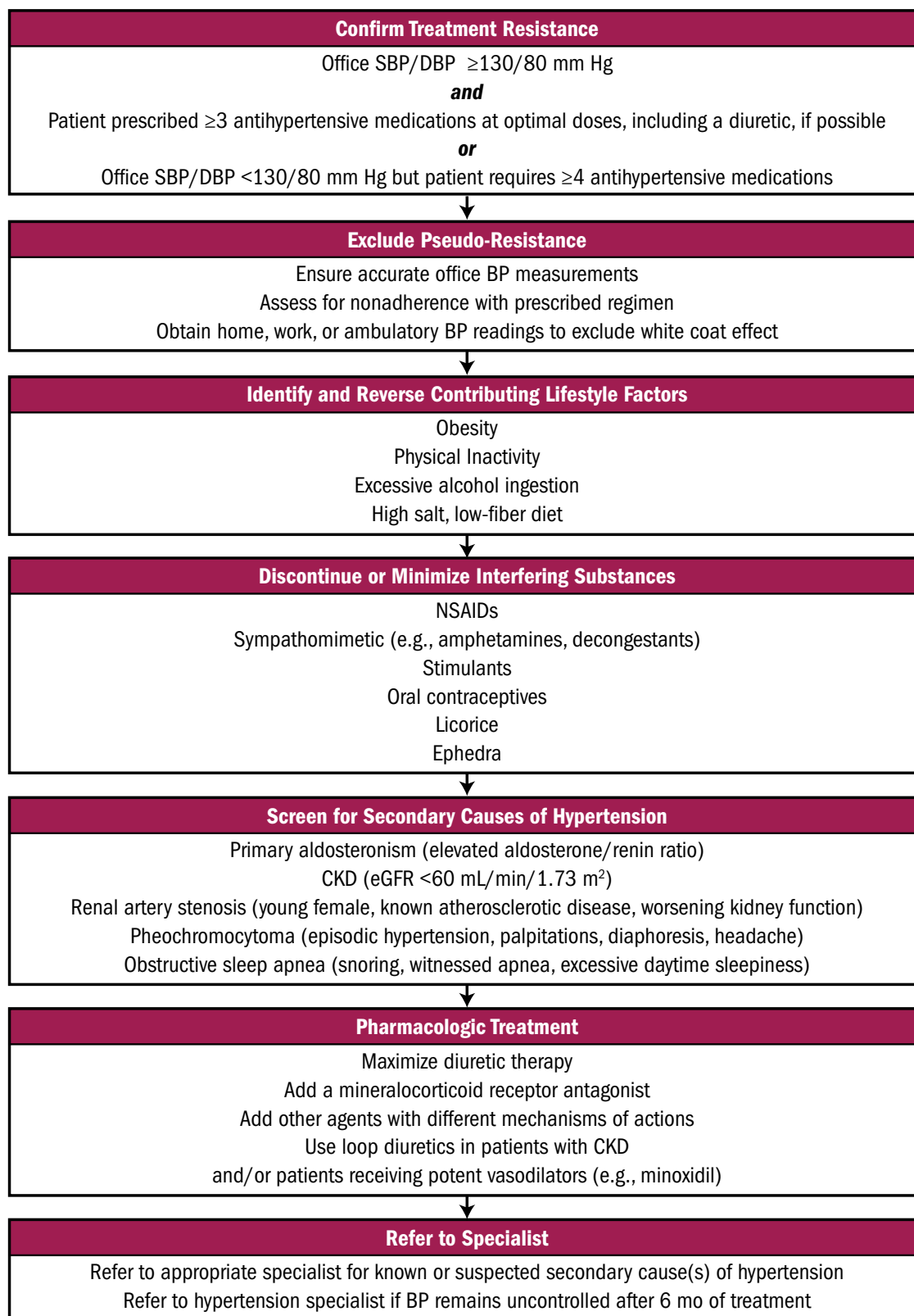


Figure 9



## Resistant Hypertension: Diagnosis, Evaluation, and Treatment

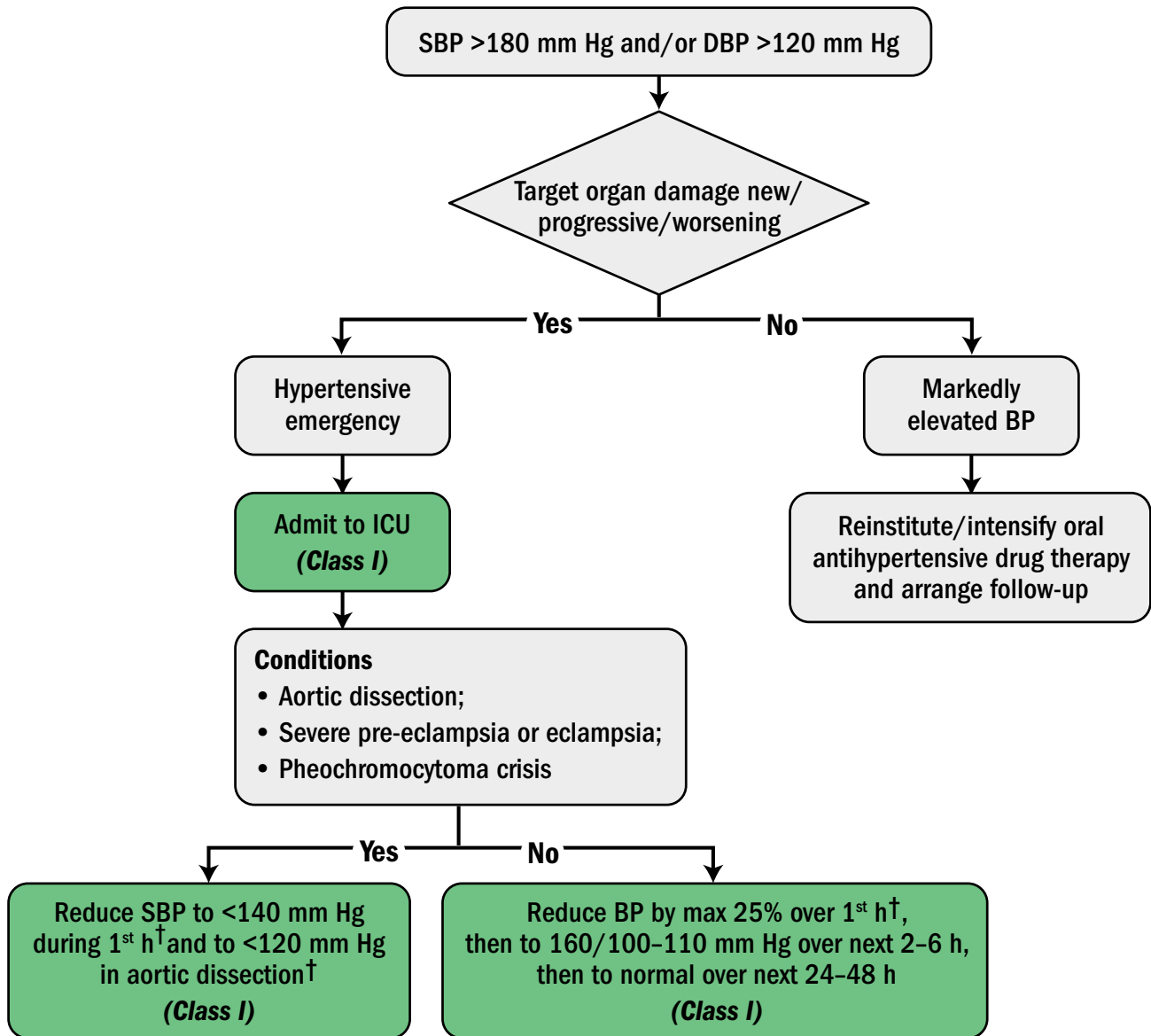


Adapted with permission from Calhoun DA, Jones D, Textor S, et al. Resistant hypertension: diagnosis, evaluation, and treatment. A scientific statement from the American Heart Association Professional Education Committee of the Council for High Blood Pressure Research. *Hypertension*. 2008; 51:1403-19

Figure 10



## Diagnosis and Management of a Hypertensive Crisis



Use drug(s) specified in Table 19.

†If other comorbidities are present, select a drug specified in Table 20.

Figure 11

## Intravenous Antihypertensive Drugs for Treatment of Hypertensive Emergencies (1 of 2)

Agent	Drugs	Usual Dose Range	Comments
CCB-dihydropyridines	<b>Nicardipine</b>	Initial 5 mg/h, increasing every 5 min by 2.5 mg/h to maximum 15 mg/h.	Contraindicated in advanced aortic stenosis; no dose adjustment needed for elderly.
	<b>Clevidipine</b>	Initial 1–2 mg/h, doubling every 90 s until BP approaches target, then increasing by < double every 5–10 min; maximum dose 32 mg/h; maximum duration 72 h.	Contraindicated in pts with soybean, soy product, egg, and egg product allergy and in pts with defective lipid metabolism (e.g., pathological hyperlipidemia, lipoid nephrosis or acute pancreatitis). Use low-end dose range for elderly pts.
Vasodilators-nitric oxide dependent	<b>Sodium nitroprusside</b>	Initial 0.3–0.5 mcg/kg/min; increase in increments of 0.5 mcg/kg/min to achieve BP target; maximum dose 10 mcg/kg/min; duration of treatment as short as possible. For infusion rates $\geq 4$ –10 mcg/kg/min or duration >30 min, thiosulfate can be coadministered to prevent cyanide toxicity.	Intra-arterial BP monitoring recommended to prevent “overshoot”. Lower dosing adjustment required for elderly. Tachyphylaxis common with extended use. Cyanide toxicity with prolonged use can result in irreversible neurologic changes and cardiac arrest.
	<b>Nitroglycerin</b>	Initial 5 mcg/min; increase in increments of 5 mcg/min every 3–5 min to a maximum of 20 mcg/min.	Use only in pts with acute coronary syndrome and/or acute pulmonary edema. Do not use in volume-depleted pts.
Vasodilators-direct	<b>Hydralazine</b>	Initial 10 mg via slow IV infusion (maximum initial dose 20 mg); repeat every 4–6 h as needed.	BP begins to decrease within 10–30 min and the fall lasts 2–4 h. Unpredictability of response and prolonged duration of action do not make hydralazine a desirable first-line agent for acute treatment in most pts.
Adrenergic blockers beta1 receptor selective antagonist	<b>Esmolol</b>	Loading dose 500–1,000 mcg/kg/min over 1 min followed by a 50 mcg/kg/min infusion. For additional dosing, the bolus dose is repeated and the infusion increased in 50 mcg/kg/min increments as needed to a maximum of 200 mcg/kg/min.	Contraindicated in pts with concurrent beta-blocker therapy, bradycardia and/or decompensated HF. Monitor for bradycardia. May worsen HF. Higher doses may block beta2 receptors and impact lung function in reactive airway disease.

Table will be continued in the next page



## Intravenous Antihypertensive Drugs for Treatment of Hypertensive Emergencies (2 of 2)

Agent	Drugs	Usual Dose Range	Comments
Adrenergic blockers-combined alpha1 and nonselective beta receptor antagonist	<b>Labetalol</b>	Initial 0.3–1.0 mg/kg dose (maximum 20 mg) slow IV injection every 10 min or 0.4–1.0 mg/kg/h IV infusion up to 3 mg/kg/h. Adjust rate up to total cumulative dose of 300 mg. This dose can be repeated every 4–6 h.	Contraindicated in reactive airways disease or chronic obstructive pulmonary disease. Especially useful in hyperadrenergic syndromes. May worsen HF and should not be given in pts with 2nd or 3rd degree heart block or bradycardia.
Adrenergic blockers-non-selective alpha receptor antagonist	<b>Phentolamine</b>	IV bolus dose 5 mg. Additional bolus doses every 10 min as needed to lower BP to target.	Used in hypertensive emergencies induced by catecholamine excess (pheochromocytoma, interactions between monamine oxidase inhibitors and other drugs or food, cocaine toxicity, amphetamine overdose or clonidine withdrawal).
Dopamine1-receptor selective agonist	<b>Fenoldopam</b>	Initial 0.1–0.3 mcg/kg/min; may be increased in increments of 0.05–0.1 mcg/kg/min every 15 min until target BP is reached. Maximum infusion rate 1.6 mcg/kg/min.	Contraindicated in pts at risk for increased intraocular pressure (glaucoma) or intracranial pressure and those with sulfite allergy.
Angiotensin converting enzyme inhibitor	<b>Enalaprilat</b>	Initial 1.25 mg over a 5 min period. Doses can be increased up to 5 mg every 6 h as needed to achieve BP target.	Contraindicated in pregnancy and should not be used in acute MI or bilateral renal artery stenosis. Mainly useful in hypertensive emergencies associated with high plasma renin activity. Dose not easily adjusted. Relatively slow onset of action (15 min) and unpredictability of BP response.

Table 19

