Hypertension Managment Refresher

By: Yaga Saine

Hypertension

According to the CDC hypertension affects nearly 108 million people in the USA. However, only about 26 million have their blood pressure controlled to ≤130/80 mmHg. Hypertension is a major preventable risk factor for heart disease, chronic/end stage kidney disease and stroke.

(CDC, 2020)

Disclosure

Investigator for Medtronic Spyral Affirm Trial (Renal denervation). The relevant financial relationships have been mitigated. Other speakers, planners and CME Staff do not have any relevant financial relationships with ineligible companies to disclose.

Old Hypertension Classification

Table 1. Classification and management of blood pressure for adults*

BP Classification	SBP* mmHg	DBP* mmHg	Lifestyle Modification	Initial drug therapy	
				Without Compelling Indication	With Compelling Indications (See Table 8)
Normal	<120	and <80	Encourage		
Prehypertension	120–139	or 80–89	Yes	No antihypertensive drug indicated.	Drug(s) for compelling indications.‡
Stage 1 Hypertension	140–159	or 90–99	Yes	Thiazide-type diuretics for most. May consider ACEI, ARB, BB, CCB, or combination.	Drug(s) for the compelling indications.‡ Other antihypertensive drugs (diuretics, ACEI, ARB, BB, CCB) as needed.
Stage 2 Hypertension	≥160	or ≥100	Yes	Two-drug combination for most† (usually thiazide-type diuretic and ACEI or ARB or BB or CCB).	

(U.S. Department Of Health And Human Services et al., 2003)

New Hypertension Classification

Blood Pressure Categories

American Heart Association | American Stroke Association

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

(LeWine, 2024)

Diagnosing HTN

- Hypertension is diagnosed using an average of 2 or readings greater than 130/80 on 2 or occasions.

HTN Risk factors

- Common substances that affect blood pressures.
  - Alcohol
  - NSAIDs and COX-2 inhibitors
  - Oral contraceptives
  - Some antidepressants
  - Sympathomimetics (decongestants, diet pills, cocaine)
  - Stimulants (methylphenidate, dexmethylphenidate, dextroamphetamine, amphetamine, methamphetamine, modafinil)
  - Corticosteroids
  - Cyclosporine
  - Tacrolimus
  - Erythropoietin stimulating agents.
  - Natural licorice
  - Chewing tobacco (some types)
  - MAO inhibitors
  - Dietary and herbal supplements (ginseng, ephedra, mahua Ng, bitter orange

HTN Risk Factors

- Secondary Hypertension Differential Diagnosis:
  - Obstructive Sleep Apnea
  - Hyperaldosteronism (fatigue, hypokalemia not responsive to potassium supplement);
  - Diagnostic screening: plasma aldosterone/renin ratio
  - Imaging Studies (CT or MRI to rule out adrenal hyperplasia VS adrenal adenoma)

Less common causes of HTN

- Less common causes of Secondary HTN
  - Cushing’s disease
  - Coarctation of the aorta
  - Renal artery stenosis (renal ultrasound)
  - Fibromuscular dysplasia (FMD) renal artery narrowing or bulge
  - Thyroid disease
  - Hyperparathyroidism

Less common Cause of HTN

- Pheochromocytoma (cause by adrenal tumor) symptoms are:
  - High blood pressure
  - Headache
  - Heavy sweating
  - Rapid heartbeat
  - Tremors
  - Paleness in the face
  - Shortness of breath

- Panic attack-type symptoms

Treatments for HTN: Lifestyle modification

Table 5. Lifestyle modifications to manage hypertension*†

Modification	Recommendation	Approximate SBP Reduction (Range)
Weight reduction	Maintain normal body weight (body mass index 18.5–24.9 kg/m^2).	5–20 mmHg/10 kg weight loss[23,24]
Adopt DASH eating plan	Consume a diet rich in fruits, vegetables, and lowfat dairy products with a reduced content of saturated and total fat.	8–14 mmHg[25,26]
Dietary sodium reduction	Reduce dietary sodium intake to no more than 100 mmol per day (2.4 g sodium or 6 g sodium chloride).	2–8 mmHg[25–27]
Physical activity	Engage in regular aerobic physical activity such as brisk walking (at least 30 min per day, most days of the week).	4–9 mmHg[28,29]
Moderation of alcohol consumption	Limit consumption to no more than 2 drinks (1 oz or 30 mL ethanol; e.g., 24 oz beer, 10 oz wine, or 3 oz 80-proof whiskey) per day in most men and to no more than 1 drink per day in women and lighter weight persons.	2–4 mmHg[30]

DASH, Dietary Approaches to Stop Hypertension.

* For overall cardiovascular risk reduction, stop smoking.

† The effects of implementing these modifications are dose and time dependent, and could be greater for some individuals.

(U.S. Department Of Health And Human Services et al., 2003)

Oral Antihypertensive Drugs

Table 6. Oral antihypertensive drugs*

CLASS	DRUG (TRADE NAME)	USUAL DOSE RANGE IN MG/DAY	USUAL DAILY FREQUENCY
Thiazide diuretics	Chlorothiazide (Diuril)	125-500	1-2
	chlorthalidone (generic)	12.5-25	1
	hydrochlorothiazide (Microzide, HydroDIURIL†)	12.5-50	1
	polythiazide (Renese)	2-4	1
	indapamide (Lozol†)	1.25-2.5	1
	metolazone (Mykrox)	0.5-1.0	1
	metolazone (Zaroxolyn)	2.5-5	1
Loop diuretics	bumetanide (Bumex†)	0.5-2	2
	furosemide (Lasix†)	20-80	2
	torsemide (Demadex†)	2.5-10	1
Potassium-sparing diuretics	amiloride (Midamor†)	5-10	1-2
	triamterene (Dyrenium)	50-100	1-2
Aldosterone receptor blockers	eplerenone (Inspra)	50-100	1
	spironolactone (Aldactone†)	25-50	1
BBs	atenolol (Tenormin†)	25-100	1
	betaxolol (Kerlone†)	5-20	1
	bisoprolol (Zebeta†)	2.5-10	1
	metoprolol (Lopressor†)	50-100	1-2
	metoprolol extended release (Toprol XL)	50-100	1
	nadolol (Corgard†)	40-120	1
	propranolol (Inderal†)	40-160	2
	propranolol long-acting (Inderal LA†)	60-180	1
	timolol (Blocadren†)	20-40	2
BBs with intrinsic sympathomimetic activity	acebutolol (Sectral†)	200-800	2
	penbutolol (Levatol)	10-40	1
	pindolol (generic)	10-40	2
Combined alpha- and BBs	carvedilol (Coreg)	12.5-50	2
	labetalol (Normodyne, Trandate†)	200-800	2

(U.S. Department Of Health And Human Services et al., 2003)

Oral Antihypertensive drugs

Table 6. Oral antihypertensive drugs* (CONTINUED)

CLASS	DRUG (TRADE NAME)	USUAL DOSE RANGE IN MG/DAY	USUAL FREQU
ACEIs	benazepril (Lotensin†)	10-40	1
	captopril (Capoten†)	25-100	2
	enalapril (Vasotec†)	5-40	1-2
	fosinopril (Monopril)	10-40	1
	lisinopril (Prinivil, Zestril†)	10-40	1
	moexipril (Univasc)	7.5-30	1
	perindopril (Aceon)	4-8	1
	quinapril (Accupril)	10-80	1
	ramipril (Altace)	2.5-20	1
	trandolapril (Mavik)	1-4	1
Angiotensin II antagonists	candesartan (Atacand)	8-32	1
	eprosartan (Teveten)	400-800	1-2
	irbesartan (Avapro)	150-300	1
	losartan (Cozaar)	25-100	1-2
	olmesartan (Benicar)	20-40	1
	telmisartan (Micardis)	20-80	1
	valsartan (Diovan)	80-320	1-2
CCBs—non-Dihydropyridines	Diltiazem extended release (Cardizem CD, Dilacor XR, Tiazac†)	180-420	1
	diltiazem extended release (Cardizem LA)	120-540	1
	verapamil immediate release (Calan, Isoptin†)	80-320	2
	verapamil long acting (Calan SR, Isoptin SR†)	120-480	1-2
	verapamil—Coer, Covera HS, Verelan PM)	120-360	1
CCBs—Dihydropyridines	amlodipine (Norvasc)	2.5-10	1
	felodipine (Plendil)	2.5-20	1
	isradipine (Dynacirc CR)	2.5-10	2
	nicardipine sustained release (Cardene SR)	60-120	2
	nifedipine long-acting (Adalat CC, Procardia XL)	30-60	1
	nisoldipine (Sular)	10-40	1

(U.S. Department Of Health And Human Services et al., 2003)

Oral Antihypertensive Drugs

Table 6. Oral antihypertensive drugs* (CONTINUED)

CLASS	DRUG (TRADE NAME)	USUAL DOSE RANGE IN MG/DAY	USUAL DA FREQUENC
Alpha-1 blockers	doxazosin (Cardura)	1-16	1
	prazosin (Minipress†)	2-20	2-3
	terazosin (Hytrin)	1-20	1-2
Central alpha-2 agonists and other centrally acting drugs	clonidine (Catapres†)	0.1-0.8	2
	clonidine patch (Catapres-TTS)	0.1-0.3	1 wkly
	methyldopa (Aldomet†)	250-1,000	2
	reserpine (generic)	0.1-0.25	1
	guanfacine (Tenex†)	0.5-2	1
Direct vasodilators	hydralazine (Apresoline†)	25-100	2
	minoxidil (Loniten†)	2.5-80	1-2

* In some patients treated once daily, the antihypertensive effect may diminish toward the end of the dosing interval (trough effect). BP should be measured just prior to dosing to determine if satisfactory BP control is obtained. Accordingly, an increase in dosage or frequency may need to be considered. These dosages may vary from those listed in the "Physicians Desk Reference, 57th ed."

† Available now or soon to become available in generic preparations.

Source: Physicians' Desk Reference. 57 ed. Montvale, NJ: Thomson PDR, 2003

(U.S. Department Of Health And Human Services et al., 2003)

Oral Antihypertensive Drugs

Table 7. Combination drugs for hypertension

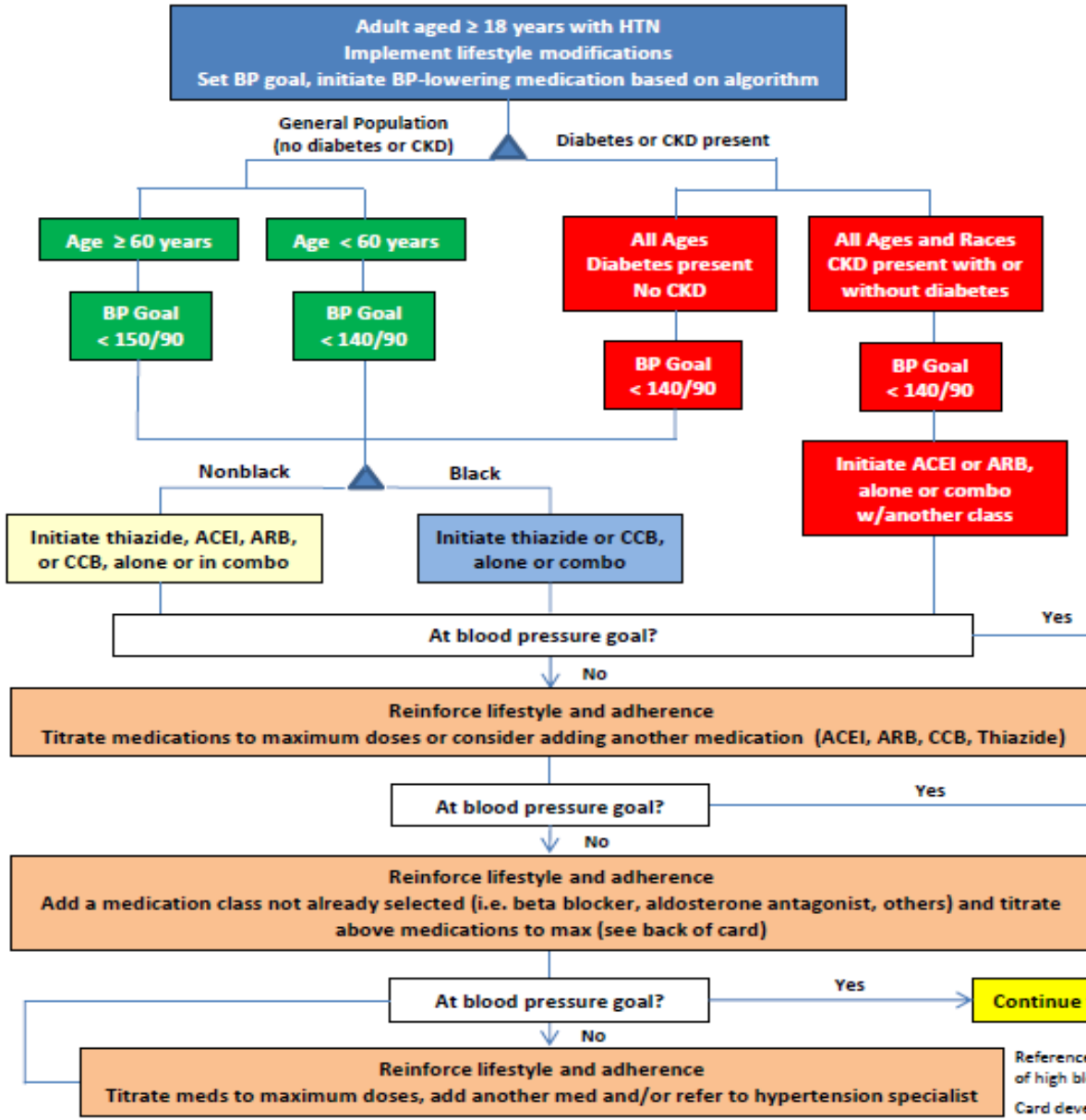
Combination Type*	Fixed-Dose Combination, mg†	Trade Name
ACEIs and CCBs	Amlodipine-benazepril hydrochloride (2.5/10, 5/10, 5/20, 10/20)	Lotrel
	Enalapril-felodipine (5/5)	Lexxel
	Trandolapril-verapamil (2/180, 1/240, 2/240, 4/240)	Tarka
ACEIs and diuretics	Benazepril-hydrochlorothiazide (5/6.25, 10/12.5, 20/12.5, 20/25)	Lotensin HCT
	Captopril-hydrochlorothiazide (25/15, 25/25, 50/15, 50/25)	Capozide
	Enalapril-hydrochlorothiazide (5/12.5, 10/25)	Vaseretic
	Fosinopril-hydrochlorothiazide (10/12.5, 20/12.5)	Monopril/HCT
	Lisinopril-hydrochlorothiazide (10/12.5, 20/12.5, 20/25)	Prinzide, Zestoretic
	Moexipril-hydrochlorothiazide (7.5/12.5, 15/25)	Uniretic
	Quinapril-hydrochlorothiazide (10/12.5, 20/12.5, 20/25)	Accuretic
ARBs and diuretics	Candesartan-hydrochlorothiazide (16/12.5, 32/12.5)	Atacand HCT
	Eprosartan-hydrochlorothiazide (600/12.5, 600/25)	Teveten-HCT
	Irbesartan-hydrochlorothiazide (150/12.5, 300/12.5)	Avalide
	Losartan-hydrochlorothiazide (50/12.5, 100/25)	Hyzaar
	Olmesartan medoxomil-hydrochlorothiazide (20/12.5,40/12.5,40/25)	Benicar HCT
	Telmisartan-hydrochlorothiazide (40/12.5, 80/12.5)	Micardis-HCT
	Valsartan-hydrochlorothiazide (80/12.5, 160/12.5, 160/25)	Diovan-HCT
BBs and diuretics	Atenolol-chlorthalidone (50/25, 100/25)	Tenoretic
	Bisoprolol-hydrochlorothiazide (2.5/6.25, 5/6.25, 10/6.25)	Ziac
	Metoprolol-hydrochlorothiazide (50/25, 100/25)	Lopressor HCT
	Nadolol-bendroflumethiazide (40/5, 80/5)	Corzide
	Propranolol LA-hydrochlorothiazide (40/25, 80/25)	Inderide LA
	Timolol-hydrochlorothiazide (10/25)	Timolide
Centrally acting drug and diuretic	Methyldopa-hydrochlorothiazide (250/15, 250/25, 500/30, 500/50)	Aldoril
	Reserpine-chlothalidone (0.125/25, 0.25/50)	Demi-Regroton, Regroton
	Reserpine-chlorothiazide (0.125/250, 0.25/500)	Diupres
	Reserpine-hydrochlorothiazide (0.125/25, 0.125/50)	Hydropres
Diuretic and diuretic	Amiloride-hydrochlorothiazide (5/50)	Moduretic
	Spironolactone-hydrochlorothiazide (25/25, 50/50)	Aldactazide
	Triamterene-hydrochlorothiazide (37.5/25, 75/50)	Dyazide, Maxzide

* Drug abbreviations: BB, beta-blocker; ACEI, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; CCB, calcium channel blocker.

† Some drug combinations are available in multiple fixed doses. Each drug dose is reported in milligrams.

(U.S. Department Of Health And Human Services et al., 2003)

JNC 8 Hypertension Guideline Algorithm



Initial Drugs of Choice for Hypertension
- ACE inhibitor (ACEI)
- Angiotensin receptor blocker (ARB)
- Thiazide diuretic
- Calcium channel blocker (CCB)

Strategy	Description
A	Start one drug, titrate to maximum dose, and then add a second drug.
B	Start one drug, then add a second drug before achieving max dose of first
C	Begin 2 drugs at same time, as separate pills or combination pill. Initial combination therapy is recommended if BP is greater than 20/10mm Hg above goal

Lifestyle changes:
- Smoking Cessation
- Control blood glucose and lipids
- Diet
  - ✓Eat healthy (i.e., DASH diet)
  - ✓Moderate alcohol consumption
  - ✓Reduce sodium intake to no more than 2,400 mg/day
- Physical activity
  - ✓Moderate-to-vigorous activity 3-4 days a week averaging 40 min per session.

Reference: James PA, Ortiz E, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: (JNC8). JAMA. 2014 Feb 5;311(5):507-20

Card developed by Cole Glenn, Pharm.D. & James L Taylor, Pharm.D.

(Glenn & Taylor, 2019)

JNC 8 Hypertension Guiddeline Algorithm

Compelling Indications	
Indication	**Treatment Choice**
Heart Failure	ACEI/ARB + BB + diuretic + spironolactone
Post –MI/Clinical CAD	ACEI/ARB AND BB
CAD	ACEI, BB, diuretic, CCB
Diabetes	ACEI/ARB, CCB, diuretic
CKD	ACEI/ARB
Recurrent stroke prevention	ACEI, diuretic
Pregnancy	labetolol (first line), nifedipine, methyldopa

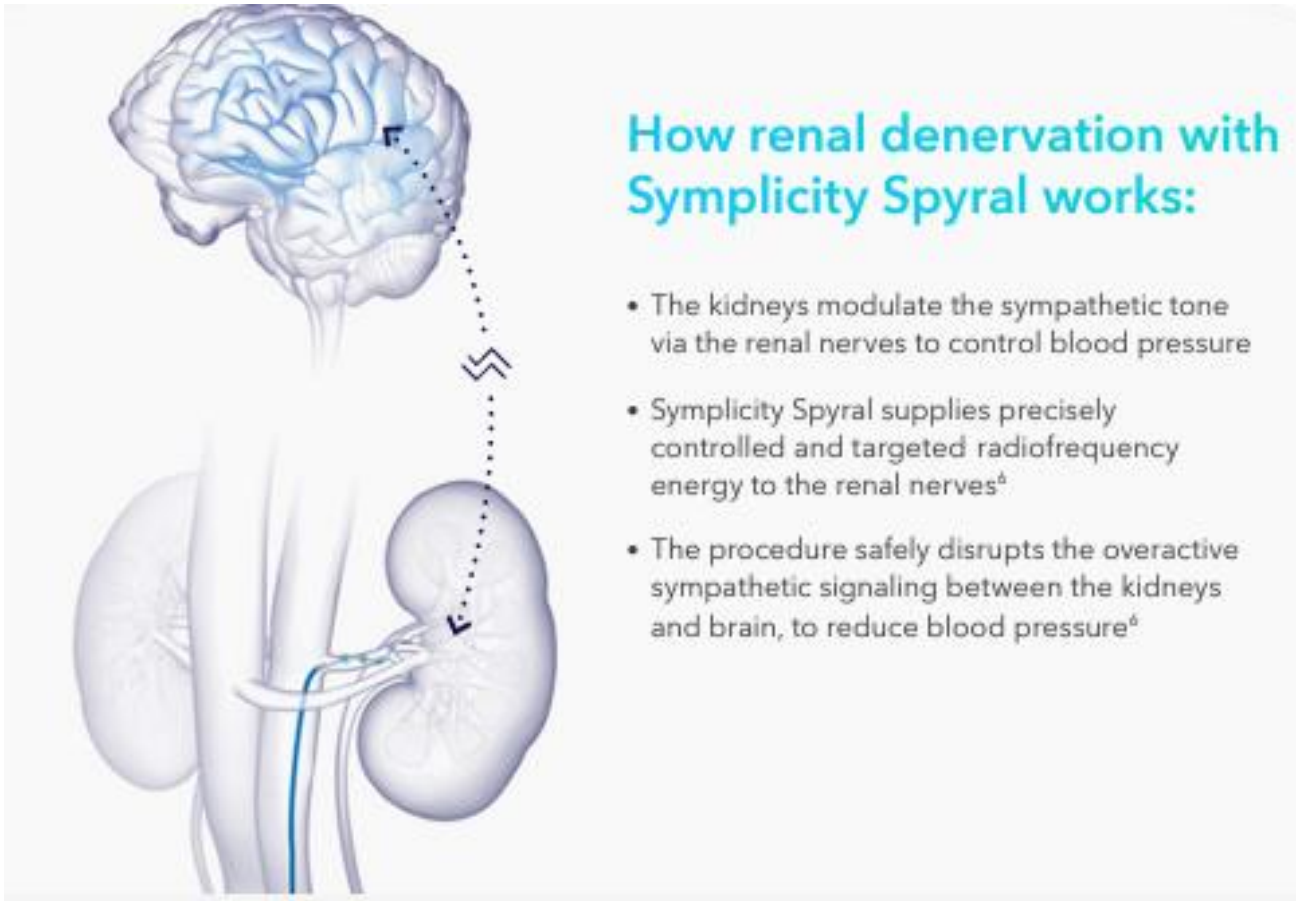
Hypertension Treatment

Beta-1 Selective Beta-blockers – possibly safer in patients with COPD, asthma, diabetes, and peripheral vascular disease:
- metoprolol
- bisoprolol
- betaxolol
- acebutolol

Drug Class	Agents of Choice	Comments
Diuretics	HCTZ 12.5-50mg, chlorthalidone 12.5-25mg, indapamide 1.25-2.5mg triamterene 100mg *K+ sparing* – spironolactone 25-50mg, amiloride 5-10mg, triamterene 100mg furosemide 20-80mg twice daily, torsemide 10-40mg	Monitor for hypokalemia Most SE are metabolic in nature Most effective when combined w/ ACEI Stronger clinical evidence w/chlorthalidone Spironolactone - gynecomastia and hyperkalemia Loop diuretics may be needed when GFR <40mL/min
ACEI/ARB	*ACEI:* lisinopril, benazapril, fosinopril and quinapril 10-40mg, ramipril 5-10mg, trandolapril 2-8mg *ARB*: candesartan 8-32mg, valsartan 80-320mg, losartan 50-100mg, olmesartan 20-40mg, telmisartan 20-80mg	SE: Cough (ACEI only), angioedema (more with ACEI), hyperkalemia Losartan lowers uric acid levels; candesartan may prevent migraine headaches
Beta-Blockers	metoprolol succinate 50-100mg and tartrate 50-100mg twice daily, nebivolol 5-10mg, propranolol 40-120mg twice daily, carvedilol 6.25-25mg twice daily, bisoprolol 5-10mg, labetalol 100-300mg twice daily,	Not first line agents – reserve for post-MI/CHF Cause fatigue and decreased heart rate Adversely affect glucose; mask hypoglycemic awareness
Calcium channel blockers	*Dihydropyridines*: amlodipine 5-10mg, nifedipine ER 30-90mg, *Non-dihydropyridines*: diltiazem ER 180-360 mg, verapamil 80-120mg 3 times daily or ER 240-480mg	Cause edema; dihydropyridines may be safely combined w/ B-blocker Non-dihydropyridines reduce heart rate and proteinuria
Vasodilators	hydralazine 25-100mg twice daily, minoxidil 5-10mg terazosin 1-5mg, doxazosin 1-4mg given at bedtime	Hydralazine and minoxidil may cause reflex tachycardia and fluid retention – usually require diuretic + B-blocker Alpha-blockers may cause orthostatic hypotension
Centrally-acting Agents	clonidine 0.1-0.2mg twice daily, methyldopa 250-500mg twice daily guanfacine 1-3mg	Clonidine available in weekly patch formulation for resistant hypertension

(Glenn & Taylor, 2019)

Simplicity Spyral Renal Denervation



How Renal denervation works in controlling Blood Pressure

During renal denervation, interventionalist (cardiologist) uses the Symplicity Spyral RDN system to ablate the renal nerves, safely disrupting the overactive sympathetic signaling between the kidneys and brain to help reduce blood pressure.

To claim CME credit (Must complete by 12-27-2024)

- Scan QR Code or click on the link below-

- iPhone: use camera to take you to the site
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- Contact carla.griffin@centracare.com with questions or for a CME transcript.

Citations

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