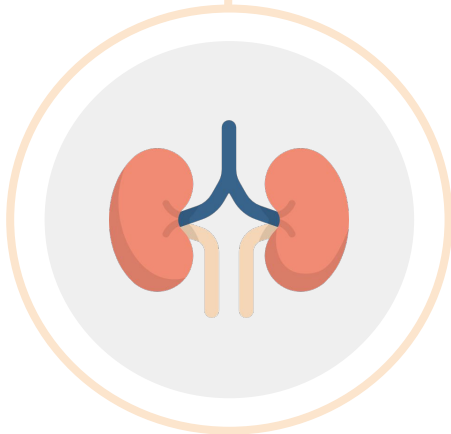


# Hypertension



## Objectives :

- ★ To be able to recognize the definition of hypertension.
- ★ To be able to identify the stages of hypertension ( ACC/AHA -European society of cardiology/European society of hypertension (ESC/ESH).
- ★ To find out the complication of hypertension.
- ★ To learn how to measure blood pressure.
- ★ To acquire knowledge on how to treat hypertension.

### ★ **Dr: What I want you to know :**

- How to measure BP in a good setting?
- **How** to diagnose HTN? and **when** to diagnose “numbers”?
- When to start treating high BP?
- How to treat? and what is the target of treatment?
- Common complications of the medications
- Common complications of HTN

## Color index

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## Definition

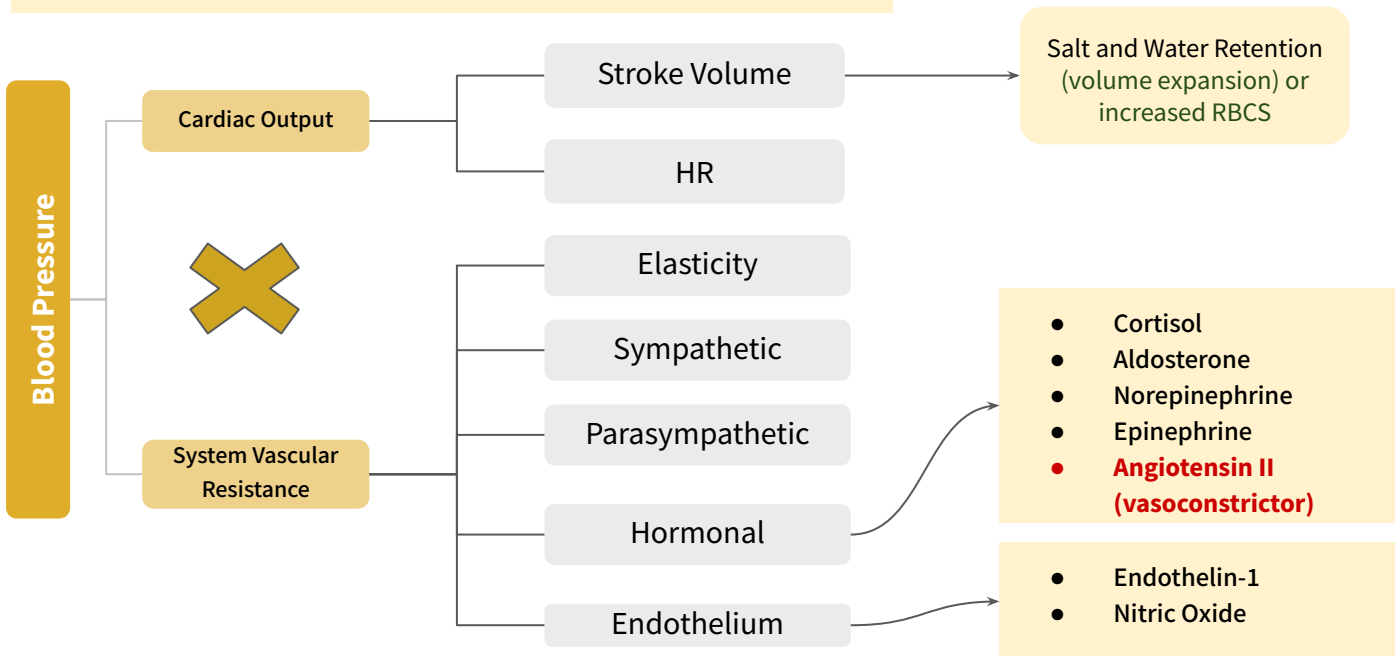
Hypertension is a condition in which arterial BP is chronically elevated. BP occurs within a continuous range, so cutoff levels are defined according to their effect on patients' risk.

## ◀ Epidemiology of Hypertension:

Dr: "Prevalence is **not** something for you to remember"

- The global prevalence of hypertension was estimated to be 1.13 billion in 2015
- The 4th most common cause of death worldwide.
- 20% of deaths worldwide are related to hypertension.
- The overall prevalence of hypertension in adults is around 30 - 45% .
- The onset of **primary hypertension** ranges between 25 to 55 years, **mainly in 40 to 50**.<sup>1</sup>.
- The overall prevalence of hypertension in Saudi is 25.5-31.4%.
- More common with advancing age.
- Prevalence of >60% in people aged >60 years.
- **Only 72% are aware of their disease**<sup>2</sup>.
- 55% of participants on medication for hypertension had their blood pressure uncontrolled<sup>3</sup>.

## ◀ Mechanism of Blood Pressure:



Recall from cardio physiology:  $BP = CO (SV \times HR) \times SVR$ . So increasing CO or SVR will increase BP.

**What are the determinants of SVR?**

1. **Loss of Elasticity:** Vessels in old ppl are stiff and rigid due to loss of elasticity so it doesn't Vasodilate → ↑BP
2. **Sympathetic activation:** e.g. Anxiety and stress → ↑BP
3. **Parasympathetic activation:** When baroreceptors in carotid are stimulated → Activate Beta-receptors → vasodilation → ↓BP
4. **Hormones:** Think of adrenal gland hormone and angiotensin II. **Angiotensin II is the most important hormone and has the strongest effect.**
5. **Endothelial factors:** Release endothelin-1 (vasoconstrictor) in response to damage of blood vessels to limit the bleeding. It also releases NO (Vasodilator)

1: if patient is younger than 40 year old, HTN is usually secondary.

2: Because HTN is a silent killer, mostly asymptomatic

3: Either due to noncompliance because of the side effects of the drugs, or the fact that they need more than one drug to control it.

# Types of Hypertension

## A. Primary (Essential) Hypertension (90-95%):

- **No cause** can be found.

### Risk Factors

Modifiable	Non-Modifiable
<ul style="list-style-type: none"> <li>• <b>Obesity</b>-metabolic syndrome</li> <li>• Unhealthy diet:               <ul style="list-style-type: none"> <li>○ <b>Excessive salt intake</b><sup>1</sup></li> <li>○ <b>low potassium intake</b><sup>2</sup></li> </ul> </li> <li>• Excessive alcohol intake</li> <li>• Polycythemia → <b>High blood volume</b> (↑SV)</li> <li>• Lack of exercise<sup>3</sup></li> <li>• Non-steroid anti-inflammatory drugs<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Family history of essential HTN</li> <li>• Aging</li> <li>• Race (<b>African american</b>)<sup>*</sup> &amp; genetic</li> </ul> <p><i>*They may carry genes that increase sensitivity to salt, which also increases the risk of high blood pressure.</i></p>

**Caffeine and smoking** (both will increase epinephrine) which **increase the BP acutely**<sup>5</sup> but are not risk factors for the development of chronic essential HTN. Hence why you shouldn't drink coffee or smoke for at least half an hour before measuring BP (Bc it will temporarily raise BP)

## B. Secondary Hypertension (5-10%):



C's



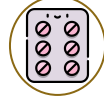
### Primary renal disease

e.g. Chronic kidney disease (CKD), Glomerulonephritis, Polycystic kidney disease (PCKD) → "enlarged kidneys" → ↑ renin → ↑ angiotensin II → vasoconstriction → ↑ BP



### Renovascular disease

The most common cause of 2ry HTN. Lead to renal ischemia → ↑ RAAS → ↑ Angiotensin II → vasoconstriction. e.g. Renal artery stenosis (RAS). In RAS you will hear **abdominal bruits** on auscultation.



### Oral Contraceptives<sup>6</sup>

As they ↑ salt and water retention, ↑ weight and ↑ production of angiotensinogen. **Other drugs:** corticosteroids, sympathomimetic agents, NSAIDs and Carbenoxolone



### Sleep apnea syndrome ★

Highly recommend you read about this topic!! [Click here](#)

Breathing-related sleep disorder and is typically associated with obesity. Have an increased risk of hypertension, heart failure, myocardial infarction and stroke.



### Primary hyperaldosteronism

AKA **Conn's syndrome**. Excess of aldosterone due to adrenal hyperplasia or adrenal adenoma. Aldosterone causes Na-water retention and hypokalemia. often asymptomatic and found to have hypertension at routine health checks.



### Cushing's syndrome

Cortisol has mineralocorticoid activity → Na<sup>+</sup> and H<sub>2</sub>O retention. Typical clinical features include central obesity, easily bruisable skin, abdominal striae, 2ry hypertension, hyperglycemia, and proximal muscle weakness.



### Pheochromocytoma

Increase production of adrenaline from adrenal gland  
**Signs & Symptoms:** Episodic Sudden attack, anxiety, tachycardia, headache, pale, sweating and hypertensive



### Coarctation of the aorta

Narrowing of aorta.  
**Signs and Symptoms:** Difference in radio-radial artery, BP in leg will be lower than the arm (Normally leg has higher pressure), **Radio-femoral delay**, Usually young and present with **claudication**



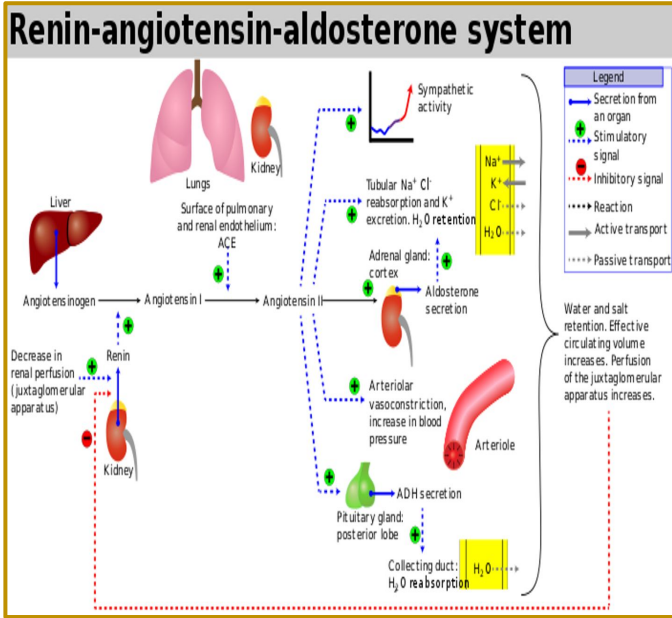
### Other endocrine

e.g. Hyperparathyroidism, Thyrotoxicosis, Acromegaly, primary hypothyroidism, congenital adrenal hyperplasia (CAH) due to 11-B-hydroxylase or 17-a-hydroxylase deficiency

1: HTN pts are advised to decrease salt intake to 2.5-3.5g.  
 2: Especially those who don't eat fruits.  
 3: Actually even those who don't lose weight but exercise may have normal BP.  
 4: causes salt and water retention.  
 5: They don't cause permanent HTN but they increase the risk of having complications in HTN patients.  
 6: Estrogen in the pills → increase production of angiotensinogen in the liver → ↑Angiotensin II → lead to vasoconstriction and high aldosterone .

Cause	Clinical history	Physical examination	Laboratory investigations	First-line test	Additional test
<b>Common causes</b>					
<b>Renal parenchymal disease</b>	History of UTI or obstruction, hematuria, analgesic abuse, family history of polycystic kidney disease	Abdominal <b>mass</b> (polycystic kidney disease)	Protein, erythrocytes or leukocytes in urine, decreased GFR	Renal <b>ultrasound</b>	Detailed work-up for kidney disease
<b>Renal artery stenosis</b> ★	<b>Fibromuscular dysplasia:</b> Early-onset hypertension (especially in women). <b>Atherosclerotic plaque:</b> Abrupt-onset hypertension, worsening or difficult to treat; flash pulmonary edema	Abdominal <b>bruit</b>	Difference of >1.5cm in length between the two kidneys (Renal ultrasound), rapid deterioration in renal function (spontaneous or in response to RAA blockers)	Renal <b>duplex doppler</b> ultrasonography	<b>Renal arteriogram: Catheter angiography</b> (intra-arterial digital subtraction angiography) <b>“GOLD STANDARD”</b>  MRI angiography, spiral CT,
<b>Primary aldosteronism</b>	Muscle <b>weakness</b> ; family history of early-onset hypertension and cerebrovascular events age <40 years	<b>Arrhythmias</b> (if severe hypokalemia)	<b>hypokalemia</b> (spontaneous or diuretic induced); incidental discovery of adrenal masses	Aldosterone:renin ratio under standardized conditions (correction of hypokalemia and withdrawal of drugs affecting RAA system)	Confirmatory test (oral sodium loading, saline infusion, fludrocortisone suppression, or captopril test); adrenal CT scan; adrenal vein sampling
<b>Uncommon causes</b>					
<b>Pheochromocytoma</b> ★	<b>paroxysmal</b> HTN; <b>headache</b> , swelling, <b>sweating</b> , palpitations, pallor; positive family history	Skin stigmata of neurofibromatosis (cafe au lait spots, neurofibromatosis)	Incidental discovery of adrenal masses (some cases are extra-adrenal)	Measurement of <b>urinary fractionated metanephrines</b> or plasma-free metanephrines	CT or MRI of abdomen and pelvis; <sup>123</sup> I-labelled meta-iodo benzyl-guidance scanning; genetic screening for pathogenic mutations
<b>Cushing's syndrome</b>	weight gain, polyuria, polydipsia, psychological disturbances	Typical body habitus (Central obesity, moon face, buffalo hump, red stria, hirsutism)	Hyperglycemia <b>Hyperlipidemia</b>	<b>24h urinary cortisol</b> excretion	Dexamethasone suppression test

## Renin-Angiotensin-Aldosterone system: ★



The RAAS is a hormone system that regulates BP and fluid balance, this system is controlled by the renal blood flow, when BP drops and/or plasma volume gets depleted the **renal perfusion will decrease**, this will stimulate the juxtaglomerular apparatus to **release Renin** into the circulation, Renin then **cleaves Angiotensinogen** -another protein from the liver- **into Angiotensin I** which will continue in the circulation to go to the Lungs and be **converted to Angiotensin II** by an enzyme called **angiotensin converting enzyme (ACE)**,

**Angiotensin II** then will cause:

- Sympathetic activation
- Na-Cl and water retention
- Arteriole vasoconstriction
- ADH secretion which will cause water reabsorption

All these effects are to compensate the Low BP and Low blood volume.

**RAAS** is inhibited when body volume and BP are normal or high.

## Classification of Blood Pressure Level

**Definition of HTN:**  
**European:** ≥140/90 (old, not used)  
**AHA:** ≥130/80  
**Know the cutoff point in both**

### American heart association classification

BP category	Systolic BP	and/or	Diastolic BP
Normal	<120 mmHg	and	<80 mmHg
Elevated	120-129 mmHg	and	<80 mmHg
<b>Hypertension</b>			
<b>Stage 1</b> ★	<b>130-139 mmHg</b>	<b>or</b>	<b>80-89 mmHg</b>
Stage 2	≥ 140 mmHg	or	≥ 90 mmHg

Notes:

- Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.
- Blood pressure should be based on an average of ≥ 2 careful readings obtained on ≥ 2 occasions.

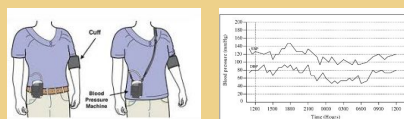
### European Society of Nephrology Classification of Blood Pressure Level (Not used anymore)

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)
Optimal blood pressure	<120	<80
Normal blood pressure	<130	<85
High-normal blood pressure	130-139	85-89
<b>Grade 1 hypertension (mild)</b>	<b>140-159</b>	<b>90-99</b>
Grade 2 hypertension (moderate)	160-179	100-109
Grade 3 hypertension (severe)	≥ 180	≥ 110
Isolated systolic hypertension	>140	<90

# Blood Pressure Measurement

**Prior to measure :** make sure that the patient didn't drink alcohol, smoked or exercised.

Types of Devices		Definition of HTN			
		SBP	DBP		
<b>Non-automated device [non-AOBP]</b>	Mercury Type Not used anymore	<b>≥140</b> ( <b>≥130</b> ACC/AHA)	<b>≥90</b> ( <b>≥80</b> ACC/AHA)		
	Aneroid Type				
<b>Half automated device</b>					
<b>Automated Device</b>					
<b>Ambulatory BP<sup>1,2,3</sup></b>	Day-time (awake)			<b>≥135</b>	<b>≥85</b>
	Night-time (sleep)			<b>≥120</b>	<b>≥70</b>
	24h	<b>≥ 130</b>	<b>≥80</b>		
<b>Home BP Monitoring (HBPM)</b>	Arm, Wrist, Finger (Finger and/or wrist BP measuring devices are not recommended) Not accurate, used in emergency only if others are not available or in obese patients	<b>≥135</b>	<b>≥85</b>		
<b>AOBP</b> <b>(Automated office blood pressure)</b> The best and most accurate device	Recommended method. (is the preferred method of performing in-office BP measurement)	<b>≥135</b>	<b>&gt;85</b>		



1: A series of automated ambulatory BP measurements obtained over 24 hours or longer provide a better profile than a limited number of clinic readings and correlate more closely with evidence of target organ damage than casual BP measurements. The average ambulatory daytime (not 24-hour or night-time) BP should be used to guide management decisions.

2: It measures BP every 30 mins over 24 hours and at the end of the day it gives you the readings summarized like that in the picture.

3: Used in patients suspected to have white coat hypertension, and patients who are diagnosed with HTN after 6 months of treatment to assess the effectiveness of the prescribed drug.



## Observe the following to obtain an accurate BP reading:

- Apply to adults on no antihypertensive medications and who are not acutely ill.
- If there is a disparity in category between the systolic and diastolic pressures, **the higher value determines the severity of the hypertension.** ALWAYS one abnormal reading (either systolic or diastolic) is enough to say pt has HTN e.g. If systolic is 120 (Normal) and diastolic is 90 (High), then the pt is said to have HTN because diastolic is high. Another example: if systolic is 150(High) and diastolic is 70(Normal) the pt is considered to have HTN
- **Measure blood pressure to arm the high reading.** Same goes for arms e.g. if BP is normal in left arm but high in right, we go with the right arm reading.



## Tips for Office blood pressure measurement:



Allow the patients to **sit for 3–5 minutes before** beginning BP measurements, Back straight and arm supported **at heart level.** Not smoking or taking caffeine for 30 mins

Take **at least two BP measurements, spaced 1–2 min apart,** and additional measurements if the first two are quite different. Consider the average BP if deemed appropriate.

use a standard bladder (12–13 cm wide and 35 cm long) A larger bladder for larger arm (circumference >32 cm). The bladder of the **pressure cuff should encircle at least 80%** of the upper arm<sup>1</sup>

## Steps in measuring BP:

# 1

**Place the cuff at the heart level,** whatever the position of the patient. Measure BP in both arms at first visit to detect possible differences. In this instance, **take the arm with the higher value as the reference.**

# 2

**Measure BP in sitting and standing position** in elderly subjects and diabetic patients<sup>2</sup> Use phase I and V (disappearance) **Korotkoff sounds** to identify systolic and diastolic BP, respectively.

# 3

The **diagnosis** of mild hypertension **should not be made until** the blood pressure has been measured on **at least two times in three visits .** Average of 10 to 15 mmHg decrease between visits 1 and three<sup>3</sup>.

Phase	Korotkoff sounds	100 mmHg systolic
I	A fluid	120 mmHg
II	A blowing noise	110 mmHg
III	A softer fluid	100 mmHg
IV	A disappearing blowing noise	90 mmHg diastolic (old)
V	Nothing	80 mmHg diastolic (2011)

Inflate the cuff till the heard sound disappears then deflate it slowly to catch the first encountered sound which is the systolic BP “korotkoff phase I”. As you continue deflating, the sound will disappear again giving you the diastolic BP “korotkoff phase V”

- 1: If it's too small it may cause **false positive high BP**, and if it is too big it may cause **false negative low BP.**
- 2: **To detect orthostatic hypotension** which could be a side effect from antihypertensive drugs. Orthostatic hypotension is defined as a **decrease by 20 mmHg in systolic pressure** or a **decrease by 10 mmHg in diastolic pressure.**
- 3: If you find high BP in distressed pts you can't diagnose them with HTN. To diagnose HTN, you have to find high BP in a normal relaxed pt. And of course this is only true if there was a mild increase in BP, but if BP is like 180/90, then he definitely has HTN. Or only 2 visits but 1 month apart.

# Different HTN Concepts

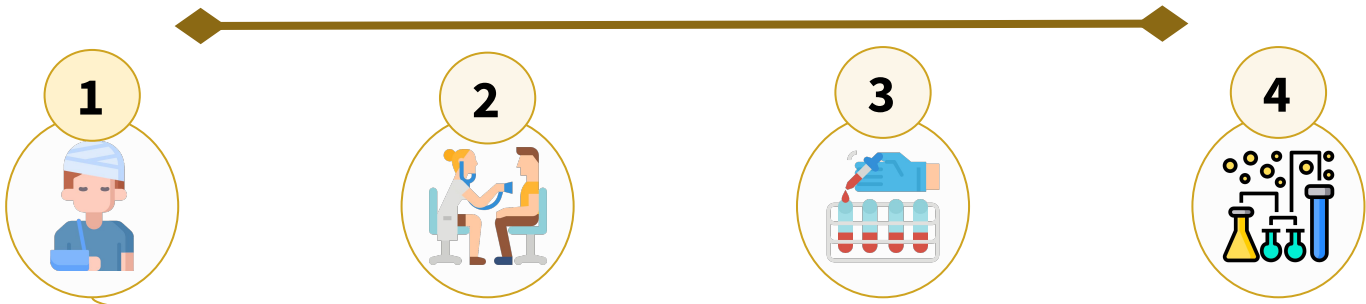
Hypertensive crisis	<b>Hypertensive Emergency</b>
	<ul style="list-style-type: none"> <li>● Severe hypertension (<b>SBP &gt;180-220 mm Hg or DBP above 120 mmHg</b>) <b>WITH end organ damage</b> (MI, STROKE, AKI, CHF) “troponin, creatinine increases”</li> <li>● If the pt left untreated he may present with stroke, sudden MI, Arrhythmia, sudden death. Admit to ICU and treat with IV antihypertensive medication.</li> </ul>
Hypertensive Urgency	<b>Malignant (Accelerated) Hypertension<sup>1</sup></b> (New name)
	<ul style="list-style-type: none"> <li>● <b>Systolic BP &gt;180-220 mm Hg or diastolic BP above 110-120 mmHg</b> with encephalopathy, retinal hemorrhages, exudates, or papilledema.</li> </ul>
“White Coat” Hypertension (Pseudo-HTN)	<ul style="list-style-type: none"> <li>● Severe hypertension (systolic BP &gt;180-220 mm Hg or diastolic blood pressure above 110-120 mmHg) in asymptomatic patients with <b>no evidence of target organ damage</b>.</li> <li>● There is no proven benefit from <b>rapid</b> reduction in BP in asymptomatic patients who have no evidence of acute end-organ and are little short-term risk.</li> <li>● The goal of therapy in these cases is to reduce BP within 24 hours.</li> <li>● Could be because the patient skipped a dose or emotional factors (e.g. Stress) or certain food</li> <li>● Treatment is oral antihypertensive. No admission needed</li> </ul>
	<ul style="list-style-type: none"> <li>● A phenomenon in which patients exhibit a blood pressure level above the normal range, in a clinical setting, though they do not exhibit it in other settings</li> <li>● Approximately 20 to 25% of patients with mild office hypertension</li> <li>● More common in <b>elderly</b>.</li> <li>● If clinic BP measurements show borderline levels of BP or if white coat hypertension is suspected, then ambulatory measurement or home-based measurements may be of value in confirming the diagnosis.</li> </ul>

- Hypertensive Crises necessitate immediate therapy to decrease BP within **minutes to hours**. usually admitted to an intensive care unit for continuous cardiac monitoring.
- However, it is unwise to reduce the BP too rapidly, since this may compromise tissue perfusion due to altered autoregulation and can lead to **cerebral damage** including **occipital blindness, renal and retinal ischaemia or MI**, Even in the presence of cardiac failure or hypertensive encephalopathy, a controlled reduction to a level of about **150/90 mmHg over a period of 24–48 hours is ideal**.
- In most cases, the aim is to reduce the diastolic BP to 100–110 mmHg over 24–48 hours. This is usually achieved with oral medication, such as **amlodipine**. The BP can then be normalized over the next 2–3 days.
- What is the best first line treatment for hypertensive crisis? **IV labetalol** is usually the best medication
- Equally acceptable forms of therapy for acute hypertensive crises are:
  - Enalapril
  - CCBs: diltiazem, verapamil
  - Esmolol
  - Hydralazine
  - Peripheral dopamine receptor antagonist: fenoldopam

1: Usually it is a common side effect of medications.



# Diagnosis



## Clinical presentation

- **Most common presentation : asymptomatic** but may also present with headache, epistaxis, chest discomfort<sup>1</sup>, Symptoms of complication (e.g. Stroke AF).
- We don't diagnose HTN based on history or symptoms, the diagnosis is made at a routine physical examination or when a complication arises. Reflecting this fact, a BP check is advisable every 5 years in adults over 40 years of age to pick up occult hypertension.



## Physical examination

- 1) Confirm the diagnosis of HTN, by obtaining accurate, representative BP measurements
- 2) Detect causes of secondary HTN.
- 3) Assess other risk factors and quantify cardiovascular risk using the calculator (explained in page 11).
- 4) Organ damage.
- 5) identify comorbidity that may influence the choice of antihypertensive therapy e.g. DM, Dyslipidemia.

Important aspects of the physical examination in the hypertensive patient
<b>Accurate measurement of blood pressure</b>
<b>General appearance</b>
Distribution of body fat
Skin lesions
Muscle strength
Alertness
<b>Fundoscopy</b>
Hemorrhage
Papilledema
Cotton-wool spots
<b>Neck</b>
Palpation and auscultation of carotids
Thyroid
<b>Heart</b>
Size
Rhythm
Sounds
<b>Lungs</b>
Rhonchi
Rales
<b>Abdomen</b>
Renal masses
Bruits over aorta or renal arteries
Femoral pulses
<b>Extremities</b>
Peripheral pulses
Edema
<b>Neurologic assessment</b>
Visual disturbance
Focal weakness
Confusion

1: ↑ BP → ↑ Afterload → ↑ Cardiac muscle size → ↑ Oxygen Demand → Angina.

# Diagnosis



## Screening

- A. Every one year for persons with systolic and diastolic pressures below  $< 120$  mmHg and 80 mmHg.
- B. Every 3-6 months for persons with systolic and diastolic pressures higher  $> 120$  mmHg and 80 mmHg.
- C. For patients above 40 years of age, If they present to the clinic with mild to moderate elevation of BP, we can not diagnose them with hypertension directly. Mild to moderate elevation needs at least 3 visits and each visit 2 readings of BP. While if the patient present with severe elevation of BP, mostly they're hypertensive.



## Laboratory tests

### Routine Tests

- **ECG** (to see if there's left ventricular hypertrophy) :
  - A. V1,2,3: Deep S wave
  - B. V4,5,6: Tall R wave
  - C. Lead I,II: LAD
- **Urinalysis:** Proteinuria or hematuria. To check whether HTN causes renal dysfunction or not.
- ★ **Electrolytes:** Serum sodium, serum potassium, creatinine, or the corresponding estimated GFR, and calcium.
- **Blood glucose**, and hematocrit (Polycythemia)
- **Lipid profile**, after 9- to 12-hour fast, that includes high density and low-density lipoprotein cholesterol, and triglycerides.

### Optional Tests

(e.g. If you suspect CKD or pt has chronic HTN)

- Measurement of urinary albumin excretion or albumin/creatinine ratio.
- **Chest X-ray:** to detect cardiomegaly, HF, coarctation of the aorta.
- **Ambulatory BP recording:** To assess borderline or 'White coat' hypertension.
- **Echocardiogram:** to detect or quantify LVH
- **Renal ultrasound:** To detect possible renal disease.
- **Renal angiography:** To detect or confirm presence of renal artery stenosis
- **Urinary catecholamines:** To detect possible pheochromocytoma.
- **Urinary cortisol & dexamethasone suppression test:** to detect possible cushing syndrome
- **Plasma renin activity and aldosterone:** to detect possible primary aldosteronism

◆ More extensive testing for identifiable causes is not generally indicated unless BP control is not achieved.

## When to treat? ★

- This is all after confirming the diagnosis ( after making sure that this is the **average BP** reading in different settings or at home measurement)

BP (mmHg)	CVD risk <sup>1</sup>	Lifestyle modifications	Drug therapy	Reassess in
<120/80	No	No	No	12 months
120-129/<80 elevated BL pressure	No	Yes	No	3 to 6 months
130-139/80-89 ★	<10%	Yes	No	3 to 6 months
130-139/80-89	≥10% (means presence of comorbid conditions like DM)	Yes	Yes (one drug)	1 month
≥140/90	NO	Yes	Yes (two drugs)	1 month

## Cardiovascular risk :

- It is the risk of having CVD based on Heart Risk Calculator which depends on many factors such as: age, race, lipid profile, presence of DM, smoking.
- So when the patient has BP of **more than 130/80 but less than 140/90**, we calculate his risk of having CVD, if the percentage was **less than 10%** we go for **lifestyle modifications** “non-pharmacological treatment” for the next 3-6 months, then we monitor BP again, if there was an improvement, lifestyle modifications should continue without drugs BUT if the BP still high we go for drug therapy.

Heart Risk Calculator

Age (years) 45.79

Gender  Male  Female

Race  African American  Other

Total cholesterol (mg/dL) 130-200

HDL cholesterol (mg/dL) 20-100

Systolic blood pressure (mmHg) 90-200

Diastolic blood pressure (mmHg) 30-140

Treated for high blood pressure  No  Yes

Diabetes  No  Yes

Smoker  No  Yes

Calculate

- So , When to treat?**
  - BP exceeding 130/80 **WITH** a CVD risk ≥ 10%? **YES** (treat)
  - BP exceeding 130/80 and less that 140/90 but CVD risk < 10%? (+/-)
  - Patients with BP ≥ 140/90? **YES** “regardless of their CVD risk”

1: Calculated by a tool that estimates the 10-year risk for atherosclerosis cardiovascular disease (ASCVD) which is defined as coronary death or nonfatal myocardial infarction, or fatal or nonfatal stroke Most of the excess morbidity and mortality associated with hypertension are attributable to CAD and many treatment guidelines are therefore based on estimates of the 10-year CAD risk. Total cardiovascular risk can be estimated by multiplying CAD risk by 4/3 (i.e. if CAD risk is 30%, cardiovascular risk is 40%).

## Antihypertensive drug treatment: ★

For essential HTN with no comorbidities

### Initial choice of medication

Aged under 55 years and  
caucasian

Aged over 55 years or black  
person of africa

(A)- ACE Inhibitors  
or  
(B)- Angiotensin receptor  
blockers

(C)- Calcium Channel Blockers  
or  
(D)- Thiazide

#### Key notes:

- A = ACE inhibitors.
- B = angiotensin II receptor blocker (ARB).
- C = Calcium channel blocker (CCB).
- D = Thiazide-like diuretic.

★ BP target of **less than 130/80 mmHg is recommended** "To reduce risks of complications".

- If BP > 20/10 mmHg above goal (140/90), may start with **2** BP lowering medications → **A(B)+C or A(B)+D** (ONE PILL DUAL COMBINATION)
- **DO NOT start with B-Blockers (Used as last option)** Unless indicated by co-morbid condition
- **DO NOT use ACEI and ARBs together**

#### → STEP 1: A(or B) or C (or D)

- **First-line therapy for patients under 55 years is an ACE inhibitor**, such as enalapril, **or** a low-cost **ARB**, such as candesartan **if ACEI is not tolerated (e.g. pt develops cough)**. In **angina** or young women of **childbearing potential**, treatment with **beta-blockers may be preferred**.
- First line therapy for patients aged 55 years and above, and black African or Caribbean patients, is a calcium-channel blocker, such as amlodipine (a thiazide-like diuretic should be used in patients with heart failure or those who develop troublesome ankle oedema). If diuretic treatment is to be initiated or changed, offer a thiazide-like diuretic, such as chlorthalidone (12.5–25.0 mg once daily) or indapamide (1.5 mg modified-release once daily or 2.5 mg once daily) in preference to a conventional thiazide diuretic such as bendroflumethiazide or hydrochlorothiazide. For people who are already having treatment with bendroflumethiazide or hydrochlorothiazide and whose blood pressure is stable and well controlled, continue treatment with the bendroflumethiazide or hydrochlorothiazide.

#### → STEP 2: A(or B) + C (or D)

- If BP control is inadequate, then the **combination** of an ACE-inhibitor or ARB with a calcium-channel blocker is recommended (or a thiazide-like diuretic as above).
- For **black people of African or Caribbean family origin**, consider an ARB in preference to an ACE inhibitor, in combination with a CCB.

#### → STEP 3: A(or B) + C + D

- Before considering step 3 treatment, review medication to ensure step 2 treatment is at optimal or best tolerated doses.
- At this point, Triple therapy of an ACE inhibitor or ARB with a calcium-channel blocker and a thiazide-like diuretic is recommended.

#### → STEP 4: Same as step 3 + more diuretic or alpha- or beta-blocker.

- If BP remains >140/90 mmHg on three agents, then the patient should be referred for specialist advice. In those with preserved renal function and resistant hypertension, spironolactone 25mg daily can be added if the serum potassium is ~4.5 mmol/L. If the potassium is >4.5mmol/L, an increased dose of thiazide-like diuretic can be used with monitoring of electrolytes (sodium and potassium) within 1 month and repeat as required thereafter. Alpha- or beta- blockers can be used if these measures are not effective.

[Click for a summary of the pharmacological therapy of HTN](#)

## ◀ High Risk Group Therapy (Special Cases):

Condition	Preferred therapy
<b>Congestive heart failure</b>	Thiazide, <b>ACEI</b> , Aldosterone antagonist, BB
<b>Post Myocardial Infarction</b>	BB, ACEi
<b>Diabetes mellitus with proteinuria</b>	ACEi, ARBs, NO ACEIs are the first line management of diabetic hypertensive patients.
<b>Diabetes mellitus without Proteinuria</b>	Thiazide, CCB, ARBs, ACEi
<b>Chronic kidney disease</b>	<b>ACEi</b> , ARBs, Thiazide
<b>Stroke</b>	CCB+ACEi
<b>Benign prostatic hyperplasia</b>	α antagonists e.g. prazosin, terazosin, doxazosin
<b>Pregnancy</b>  <b>Mnemonic:</b> Moms Love Healthy Newborn (Methyldopa, Labetalol, Hydralazine, nifedipine)	Hydralazine (vasodilator), nifedipine (CCB), Aldomet (methyldopa), labetalol <b>Oral labetalol</b> is first-line therapy during pregnancy. Second Line agents are methyldopa and nifedipine. <b>In breastfeeding</b> , ACE inhibitors, beta-blockers and nifedipine are safe. Methyldopa should be avoided because of the risk of depression.

## ★ Antihypertensive drug complications: You have to tell the pt about them

DRUG	Contraindication	ADR
<b>Thiazide Diuretics</b>	Gout	Hypokalemia
<b>Beta-Adrenergic blockers</b>	Asthma or COPD	Bradycardia
<b>ACEI</b>	Pregnancy, Renovascular disease	Hyperkalemia, Cough, <b>Angioedema</b>
<b>Angiotensin II Receptor Blocker</b>	Pregnancy	Hyperkalemia
<b>Calcium Channel Blockers</b>	AV-block, HF	Edema, Tachycardia, Bradycardia, <b>Constipation, flushing, palpitations and fluid retention</b>
<b>Alpha-Adrenoceptor Antagonist</b>	Urinary incontinence	1st dose <b>postural</b> hypotension,
<b>Drugs with Central Sympatholytic Action</b>	-	Drowsiness
<b>Arteriolar Dilators</b>	-	Tachycardia, Edema

## What is lifestyle modification?

lifestyle modification intervention	reduction in BP (mmHg)
<b>Weight loss</b>	1 mmHg/ 1kg loss
Dash-type diet	11 mmHg
Reduce dietary <b>sodium</b> (1500 mg)	5-6 mmHg
Increase dietary potassium (3500 mg)	4-5 mmHg
Aerobic exercise 90 – 150 min/week	5-8 mmHg
Reduce/ stop alcohol intake	4 mmHg

- **Weight loss:** BMI 25 kg/m.
- **DASS Diet:** high consumption of vegetables and fruits, low-fat dairy.
- Limit alcohol intake
- Vit D replacement
- Regular physical exercise: 30 min of moderate-intensity aerobic exercise 5-7 days/week.
- Smoking cessation.
- Lifestyle modification can be really effective lowering BP down to 20 mmHg returning it to normal.

**Super important :**

- ★ **NaCl (Salt restriction): 3000 mg/day**
  - ★ **Na (Sodium restriction): 1500 mg/day**
- READ THE QUESTION CAREFULLY WHETHER IT IS “SALT” OR “SODIUM” RESTRICTION.**

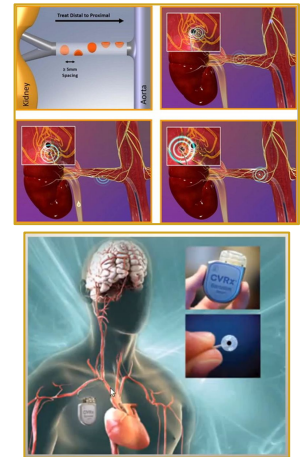
## Other treatment options:

◆ **Hypertension renal denervation:**

- A controlled trial of renal denervation for resistant hypertension. this blinded trial did not show a significant reduction of systolic blood pressure in patients with resistant hypertension 6 months after renal-artery denervation as compared with a sham control.
- RDN had significantly greater BP reductions vs sham control in both 24-hour systolic ABPM (4.0 mmHg, p<0.001), and office systolic BP (6.6 mmHg, p<0.001).

◆ **Barostim**

- An implanted device designed to activate baroreceptors to reduce blood pressure does not appear to reduce blood pressure.



## Benefits of Lowering BP:

Dr: “You don’t need to know the numbers”

- 2 mmHg decrease in mean systolic BP will lead to:
  - 7% reduction in risk of ischemic heart disease mortality
  - 10% reduction in risk of stroke mortality.
  - Reduce the risk of cardiovascular events up to 10%
- **Follow up and monitoring**
  - Patients should return for follow-up after 2-4 weeks and adjustment of medications monthly until the BP goal is reached
  - More frequent visits for stage 2 HTN or with complication comorbid conditions
  - Serum potassium and Cr monitored 1-2 times per year

Disease	Incidence reduction
Stroke	35-40%
Myocardial infarction	20-25%
Heart failure	50%
Renal failure	35-50%



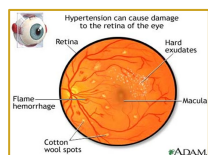
# Complications of Hypertension

## Complications

**1** **Cardiac**<sup>1</sup> ★  
CAD, Arrhythmia (Atrial fibrillation), CHF, LVH, Sudden death

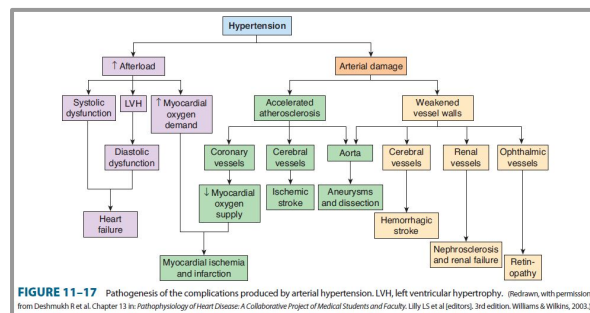
**3** **Vascular**<sup>1</sup>  
Aortic Dissection, Peripheral vascular disease, Hypertensive crisis urgency/ emergency

**5** **Eye**  
Retinal hemorrhage  
Hypertensive retinopathy



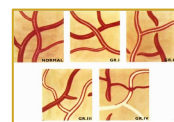
**2** **Cerebral**  
Ischemic/ Hemorrhagic Stroke, Alzheimer's disease, Cognitive imbalance


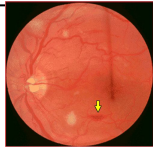
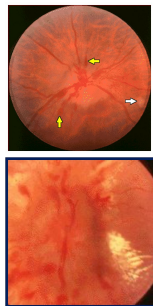
**4** **Renal disease**



## Hypertensive retinopathy:<sup>2</sup>

Dr: "I think you **don't** need to know the grades"



Grade	Description
I	<ul style="list-style-type: none"> <li>Minimal narrowing and thickening of retinal arteries and increased reflectiveness ("Silver Wiring")</li> </ul>
II	<ul style="list-style-type: none"> <li>Arteriovenous nipping (yellow arrow): Narrowing of retinal arteries in conjunction with regions of focal narrowing. Produced when thickened retinal arteries pass over the retinal veins</li> </ul> 
III	<ul style="list-style-type: none"> <li>Abnormalities seen in Grade I II, plus flame-shaped retinal hemorrhages, hard exudates and cotton wool spots, as well as copper wiring of blood vessels.</li> <li>Cotton wool exudates are associated with retinal ischemia or infarction.</li> </ul> 
IV	<ul style="list-style-type: none"> <li>Abnormalities encountered in Grade I through III, as well as swelling of the optic nerve head and macular star.</li> <li>There is blurring of the borders of the optic disk with hemorrhages (yellow arrows) and exudates.</li> <li>papilledema from malignant hypertension</li> <li>The lipid-rich component of the exudate is able to penetrate into the outer plexiform layer, creating what is clinically seen as a macular star pattern.</li> </ul> 

1: Hypertension has a number of adverse effects on the cardiovascular system. In larger arteries (>1 mm in diameter), the internal elastic lamina is thickened, smooth muscle is hypertrophied and fibrous tissue is deposited. The vessels dilate and become tortuous, and their walls become less compliant. In smaller arteries (<1 mm), hyaline arteriosclerosis occurs in the wall, the lumen narrows and aneurysms may develop. Widespread atheroma develops and may lead to coronary and cerebrovascular disease, particularly if other risk factors are present.

2: Examination of the optic fundi reveals a gradation of changes linked to the severity of hypertension; fundoscopy can, therefore, provide an indication of the arteriolar damage occurring elsewhere.

## ◀ Case 1 (From Dr slides):

- ❖ Case: A 47 years old man came to the clinic with headache for 3 weeks. The nurse measure his blood pressure and was found to be 150/ 95 mmHg .

1. **Does he have hypertension?** We can't tell by one measurements because according to AHA, HTN is defined as a systolic blood pressure  $\geq 130$  mm Hg or a diastolic blood pressure  $\geq 80$  mm Hg on at least two measurements in three visits.
2. **What is the stage of hypertension?** We can't tell.
3. **What investigation should you perform?** ECG, Urinalysis, Electrolytes, lipid profile, blood glucose.
4. **What could be your management in his case?**
5. **Is there any possible prevention to his disease and its complication?** Lifestyle modification and reassess multiple times.

## ◀ Case 2 (EXTRA):

- ❖ Case: A 35-year-old black man with no significant past medical history presents to the outpatient clinic for a follow-up examination 4 weeks after he was noted to have a blood pressure of 150/80 mm Hg on a routine health maintenance examination. He has no complaints, takes no medications, and does not smoke or use alcohol or other drugs. His family history is significant for a father with high blood pressure and a maternal grandmother who died of breast cancer. His blood pressure on this visit is 150/90 mm Hg.

1. **What's the most likely diagnosis?**  
Primary (essential) hypertension. Hypertension is defined as a systolic blood pressure  $\geq 130$  mm Hg or a diastolic blood pressure  $\geq 80$  mm Hg on three separate measurements at least 2 weeks apart. Although this patient has only had two measurements, it is likely that he will have a third that satisfies the criteria for diagnosing hypertension. Although primary hypertension is technically idiopathic, and therefore a diagnosis of exclusion, it represents 95% of all cases of hypertension. Thus, it is reasonable for physicians to begin therapy for primary hypertension without undertaking a full workup for causes of secondary hypertension, especially if there is a family history of hypertension.
2. **What are the risk factors for this condition?**  
Family history of hypertension or heart disease, High-sodium diet, Obesity, Older age, Race (blacks > whites), Smoking
3. **What are the common complications associated with this condition?**  
Because hypertension is asymptomatic until complications develop, patients who do not receive regular medical care may develop the sequelae of untreated hypertension. Specifically, untreated hypertension leads to end-organ damage: Heart (hypertrophy, myocardial infarction, CHF), Brain (stroke, TIA), Kidney (chronic kidney disease, renal failure), Vasculature (peripheral vascular disease) and Eye (retinopathy)

# Summary

## HYPERTENSION

### Definition

- Systolic pressure  $\geq 130$  mm Hg
- Diastolic pressure  $\geq 80$  mm Hg

### Etiology

95 percent of hypertension has no clear etiology and can be called “**essential hypertension**”

#### Secondary hypertension causes:

- Renal artery stenosis
- Glomerulonephritis
- Coarctation of the aorta
- Obstructive sleep apnea
- Pheochromocytoma
- Hyperaldosteronism
- Cushing syndrome

### presentation

The vast majority of cases are found on **routine screening of asymptomatic patients.**

#### Complications:

- Coronary artery disease
- Cerebrovascular disease
- CHF
- Visual disturbance
- Renal insufficiency
- Peripheral artery disease

### Diagnostic Tests

**The diagnosis of hypertension should not be made until the blood pressure has been measured on at least two times in three visits.**

Those with hypertension are also tested with:

- EKG
- Urinalysis
- Glucose measurements to exclude concomitant diabetes
- Electrolytes
- Lipid profile

### General information

- Threshold of treatment start 130/80 mm Hg if there is CVS risk. If not, it is just lifestyle modification & reassess in 3-6 months
- Blood pressure goal is  $< 130/80$  mm Hg

### initial therapy

- Age  $< 55$  → ACE or ARB
- Age  $> 55$  or Black → CCB or thiazide diuretics
- If blood pressure is very high on presentation ( $> 140/90$  mm Hg), 2 medications should be used at the outset.

### Management

### Pregnancy

Oral labetalol is first-line therapy during pregnancy. Second Line agents are methyldopa and nifedipine. In breastfeeding, ACE inhibitors, beta-blockers and nifedipine are safe. Methyldopa should be avoided because of the risk of depression.

# Lecture Quiz

**Q1:** A 48-year-old woman has been diagnosed with essential hypertension and was commenced on treatment three months ago. She presents to you with a dry cough which has not been getting better despite taking cough linctus and antibiotics. You assess the patient's medication history. Which of the following antihypertensive medications is responsible for the patient's symptoms?

- A- Amlodipine
- B- Lisinopril
- C- Bendroflumethiazide
- D- Furosemide
- E- Atenolol

**Q2:** A 57-year-old male is admitted complaining of headaches and blurring of vision. His blood pressure is found to be 240/150 mmHg and he has bilateral papilloedema, but is fully orientated and coherent. He had been known to be hypertensive for about five years and his blood pressure control had been good on three drugs. However, he had decided to stop all medication two months before this event. Which of the following would be your preferred parenteral medication at this point?

- A- Glyceryl Trinitrate
- B- Hydralazine
- C- Labetalol
- D- Sodium nitroprusside

**Q3:** A 44-year-old woman presents with episodes of headaches, associated with anxiety, sweating and a slow pulse rate. At the time of her initial consultation, her blood pressure was 150/95 mmHg seated, but 24 hour ambulatory monitoring shows a peak of 215/130 mmHg, associated with the symptoms described above. Which of the following would be your initial diagnostic procedure??

- A- Magnetic resonance imaging (MRI) scans of the abdomen and pelvis
- B- Measurement of random plasma catecholamines
- C- Measurement of urinary metanephrines over several 24 hour periods
- D- Glucose tolerance test

**Q4:** A 57-year-old man is reviewed in a hypertension clinic, where it is found that his blood pressure is 165/105 mmHg despite standard doses of amlodipine, perindopril, doxazosin and bendroflumethiazide. Electrolytes and physical examination have been, and remain, normal. Which of the following would be your next stage in his management?

- A- Arrange for his medication to be given under direct observation
- B- Add spironolactone to his medication
- C- Arrange urinary catecholamine assays
- D- Request an adrenal CT scan

**Q5:** A 41-year-old woman with type 2 diabetes attends a hypertension clinic. She has been doing well on metformin and has maintained good glycaemic control alongside dietary changes and regular physical exercise. She has been meeting her HbA1c targets consistently. However, her blood pressure has been poorly controlled despite lifestyle changes and is currently 157/97 mmHg. The most appropriate first-line therapy is?

- A- Diuretics
- B- Angiotensin II receptor blocker
- C- Calcium channel blocker
- D-  $\beta$ -blocker
- E- Angiotensin-converting enzyme (ACE) inhibitor

# GOOD LUCK!

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