

HYPERTENSION AHD

10/10/19

AGENDA:

- 1:00-1:15 Large Group: Theory Burst
- 1:15-2:15 Objective 1: Outpatient HTN
- 2:15-2:30 Break
- 2:30-2:40 Large Group: Theory Burst
- 2:40-3:10 Objective 2: Secondary HTN
- 3:10-3:25 Objective 3: HTN Urgency/Emergency

OBJECTIVE 1: Diagnose hypertension. Choose the appropriate agent(s) and BP goal in the ambulatory setting to treat hypertension in different patient populations according to guidelines.

Ms. Spike

You see Ms. Spike in resident clinic for a follow-up visit. She is a Caucasian female, 48yo, with PMHx of HLD, tobacco abuse, COPD, and morbid obesity. She was slightly hypertensive at 154/86 at her last appointment. At the time, you asked her to come back and see you within two weeks as her BP was previously controlled per chart review. Her BP today is 152/82. Prior labs show a Cr of 1.0 mg/dL, total cholesterol 243 mg/dL, HDL 36 mg/dL, & LDL 170 mg/dL.

1. Does she have a diagnosis of hypertension? Why? What are your plans?

- Diagnosis based on average of 2 or more elevated SBP & DBP ($\geq 130/80$) obtained on 2 or more occasions
- Decision to treat and goal BP depends on what guidelines you address:
 - o AHA/ACA: based on ASCVD 10-year risk and co-morbidities. Her 10-year ASCVD is 10.3%. Goal BP is $<130/80$. Since stage 2 HTN, recommends starting TWO first-line meds (THZ diuretic, CCB, ACEi/ARB)

2. What if Ms. Smith's BP was 165/110?

- Ensure accurate BP measurement just like before, check both arms
- Consider common cause of secondary HTN in an obese patient – **OSA** - given she does not have other signs/symptoms pointing toward other causes of secondary hypertension
- Ask if anyone knows what Mallampati score is
- Discuss STOPBANG questionnaire – can have someone look it up
- In this scenario, consider starting 2 antihypertensive medications: starting with two drugs should be considered in patients with a baseline blood pressure that is 20/10 mmHg or more above the goal
- As reviewed, start two of three in nonblack with DM but no CKD: THZ diuretic, ACEi/ARB, or CCB
- This patient would also need workup if not recently done (BMP, UA/UAC)

3. You decide to start Lisinopril 10 mg by mouth daily on Ms. Smith. You send the order to her pharmacy which delivers meds directly to her home. What do you discuss with her prior to leaving the office and/or put in her AVS?

- Discuss **angioedema**, symptoms, and what to do if it occurs. Can discuss other side effects as well if time allows.
- She will need **labs** checked. Patients should have a BMP (electrolytes and Cr, sodium if THZ) BEFORE starting an ACEi, ARB, or THZ as well as a repeat 2 weeks after starting (or 1-2wks after an increased dose), and at least annually.

4. When should we be concerned about adverse effects of an ACEi or ARB on renal function?

- if SCr increases >30% from baseline after 2 months and/or hyperkalemia of >5.6 mmol/L
- in patients with renal insufficiency (SCr >1.4 mg/dL) treated with ACEi, there is strong association between early (within the first 2 months) and moderate (not exceeding 30% over baseline) rise in serum creatinine
- **ASK – NOT ON SHEET: What might we consider if SCr increases >30% on Lisinopril and BP rises suddenly to >180/100?**
- RAS – to be reviewed later along with other causes of secondary hypertension, hypertensive crisis

Ms. James

Ms. James is a 42yo AAF with past medical history of well-controlled diabetes mellitus type 2. She is G2P2002 with a history of pre-eclampsia during her last pregnancy 10 years ago. She had been seeing another provider in the community who has retired and she comes to your office to establish care and for diabetes follow-up. She denies symptoms. She takes metformin 500 mg by mouth twice daily. She denies taking any other medications.

ROS negative

BMI 29

VS: BP 152/89 HR 76

PE: truncal adiposity, otherwise unremarkable

1. Ms. James is here for a new patient appointment. You decide to spend the majority of the appointment on her blood pressure. What do you plan to do during this visit?

- **Recheck BP** if not measured appropriately - this includes measuring BP in both arms at a first visit after resting comfortably for >5min, arm *supported* at the level of the heart, with appropriate cuff size (length of the bladder should be 80%, and the width of the bladder should be at least 40% of the circumference of the upper arm)
- Consider obtaining **out-of-office readings** to rule-out white coat htn – prescribe a blood pressure cuff for home checks, have patient check at drug store, etc.
- Ask about any **OTC medications** (NSAID's or herbal supplements), decrease **alcohol** intake
- **Lifestyle modifications:** exercise (40 min vigorous 3-4x/week)/weight loss, diet (consider having them look up DASH diet or 1.5 g/day), smoking cessation
- Note that **her Hx of preeclampsia** in the past may play a role in her current HTN – research shows preeclampsia either uncovers a predisposition of having/developing hypertension and may impart risk developing HTN

2. As your visit finishes up, you need to determine follow-up and finish your orders. What do you put in your AVS?

- **Lab** for the following orders: BMP (for creatinine and electrolytes), urinalysis (albuminuria), lipid profile
- She should **follow-up in 1 week** for repeat BP check.

3. Ms. James returns to clinic for repeat BP check. BP is 155/82. HR 80. BMP and UA were normal, and her A1c was 7.2%. What do you do next?

- AHA/ACA states because she has DM2 and is AA, first line is **THZ diuretic and/or CCB**
- Her goal BP depends on what guidelines you consult, SBP ≥ 140 or DBP ≥ 90 mmHg^E as she is between 18-60yo
- Could start Chlorthalidone 12.5 mg qday (1st line diuretic per AHA/ACA) or HCTZ 12.5 mg 1 tab qday or amlodipine 5 mg qday

4. Why did we order a UA?

- Can it change your management? YES but may need more detail, like urine albumin:creatinine ratio.
- **Ask** the group to define albuminuria – easiest way to measure is spot urine albumin to creatinine ratio (equally as useful as protein to creatinine ratio). Microalbuminuria = 30-300 mg/g. >300 mg/g = Macroalbuminuria
- According to ACC/AHA: If patient has CKD Target BP is $<130/90$
- in patients <70 yo, **CKD** = GFR <60 mL/min/1.73m² **or** albuminuria = ACR ≥ 30 mg albumin/g creatinine
- ACC/AHA recommends standard first line medications if no proteinuria. If proteinuria patient should be started on ACE-I or ARB.
- Important to recognize that individuals with CKD usually have multiple co-morbidities which may make it dangerous to drive BP to a low goal. Always make sure guidelines fit your patient!
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5. She returns to clinic in 4 weeks. She also reports she forgot to mention she was taking ibuprofen for nonspecific knee pain and she stopped taking it after you asked about this type of medication at the last visit. Today, blood pressure is 145/94. What do you do next?

- increase Lisinopril or add amlodipine or add HCTZ
- again, ACC/AHA says treat patients 18-59 yo in the general population (with or without DM) if SBP ≥ 140 or DBP ≥ 90 mmHg^E

6. Fast forward two months later. Ms. Smith was admitted for angioedema thought 2/2 ACEi and you happen to be on the ward team caring for her. What are your plans for discharge?

- Discuss listing Lisinopril as intolerance vs allergy. Make sure they know HOW to do this in Epic (can click on “allergy” at the top of the chart, add medication.)
- Ask what they would discharge them on. Switch to CCB? Start an ARB? Can discuss that research demonstrates 10% cross reactivity between ACEi and ARB. Emphasize shared-decision making with the patient.
- Will ask Dr. Anjak to weigh in

Mr. Cooke

Mr. Cooke is a 72 yo CM with CKD-3, hypertension, and history of NSTEMI 5 years ago s/p 2 DES to mid-LAD. He presents in clinic today for follow-up. He notices he gets dizzy occasionally upon standing. He denies other symptoms. He feels he has maintained a “good” diet and has tried to adhere to 2.5 -3 grams of salt intake/day. Medications: Aspirin 81 mg by mouth daily, Lisinopril 40 mg by mouth daily, metoprolol succinate 12.5 mg by mouth daily, amlodipine 10 mg by mouth daily and atorvastatin 40 mg by mouth daily.

ROS negative

BMI 23

VS: BP 143/56 HR 72

PE: unremarkable save for trace pitting edema bilateral lower extremities,

Labs: CBC wnl, CMP reveals GFR 50 mL/min/1.73m² (unchanged from 6 months ago), ACR 3mg/g

1. What are your thoughts regarding Mr. Cooke’s symptom of dizziness? What would you do next?

- Considerations: orthostatic hypotension, cardiac causes (arrhythmia), volume depletion, dysautonomia (though less likely unless he had Parkinson’s or DM or severe PVD this would be a consideration)
- In general we should obtain **standing BP** on all patients ≥ 70 yo, taken after 2-3min of standing, compare to seated BP
- **Ask** the group to define orthostatic hypotension - defined as a decrease of SBP >20 mmHg and/or a decrease of DBP >10 mmHg from sitting to standing (or supine to standing however in ambulatory setting we typically do not obtain supine BP because readings are, on average, about 5 mmHg less than seated)

2. Standing BP is 122/52, HR 85. Now what?

Decrease one of his BP agents – could decrease Lisinopril or Amlodipine (by how much? Would you decrease both? What about his BB?) Given his comorbidities it would be most beneficial to decrease/stop Amlodipine - keep him on an ACEi for CKD and a BB for CHD. Perhaps his trace pitting is from amlodipine?

3. When do you want to recheck BP after this change?

2 weeks. Goal is to **stop the offending cause of orthostasis** - would continue to adjust regimen to eliminate orthostasis sx and to keep goal BP $<150/90$. Ensure patient understands medication change – **teach back!**

4. Should we lower or stop antihypertensive therapy in a 75yo male with BP 133/62 who has been tolerating his medication regimen?

NO^E – Per ACC/AHA - in patients ≥ 65 yo who are not institutionalized and ambulatory goal SBP should be <130 . This is not in line with other organizations such as AFP and ACP who recommend a higher target. Again important that residents identify the need to individualize therapy for each patient

Break

Objective 2: Identify basic causes of secondary hypertension based on pathophysiology and clinical characteristics

Mr. Redding is a 67-year-old CM presenting in clinic for follow-up of longstanding hypertension. He has a 50 pack year smoking history, HLD, type 2 diabetes mellitus and obesity. He has reduced his cigarette use three years ago after a TIA. He adheres to prescribed medications including metoprolol, amlodipine, HCTZ, ASA 81 and atorvastatin 80. BP history:

BP	Time
143/81 mm Hg	1 year ago
150/92 mm Hg	6 months ago
158/93 mm Hg	3 months ago
170/99 mmHg	Today

1. What's the term used for this patient's presentation? How does this change your management?

This is drug-resistant or refractory hypertension (blood pressure that exceeds the target goal despite taking three antihypertensive drugs, one of which is a diuretic). This is a risk factor for secondary hypertension and may lead you to more testing.

Ask learners what the other risk factors are for secondary HTN:

- refractory HTN
- acute rise in BP when previously stable
- hypertensive emergency with unclear cause
- age of onset <30yo without other risk factors (obese, FMHx, etc)
- **specific Hx/PE clues as discuss below**

You decide to start Lisinopril for Mr. Redding for better blood pressure control but prior to starting you order a renal panel which reveals a SCr is 1.2. You ask Mr. Redding to return in 2 weeks for repeat renal panel after initiating Lisinopril. Repeat SCr is 1.9 today (2 week later). On physical exam you hear an abdominal systolic and diastolic bruit.

2. What is the most likely diagnosis? Explain the pathophysiology.

Classic clinical clues suggest the diagnosis of **renal-artery stenosis**:

- Onset of hypertensive urgency or difficult to control hypertension (BP >160/100 mm Hg) after 50YO (**X**)
 - o Or in the absence of a family history of hypertension
- HTN associated with renal insufficiency (**X**)
 - o Especially if acute rise in SCr >30% after ACEi or ARB started

- HTN with repeated hospital admissions for heart failure
- Drug-resistant hypertension (see above) **(X)**
- Renal asymmetry
- Severe HTN in patient with diffuse atherosclerosis **(X)**

Under-perfusion and ischemia of the kidneys causes stimulation of the renin-angiotensin system & sympathetic nervous system with sodium retention and increased volume contributing to hypertension.

Mr. Redding most likely has RAS 2/2 **atherosclerosis** (compared to FMD).

Table 1. Characteristics of Atherosclerotic Renal-Artery Stenosis and Fibromuscular Dysplasia.		
Variable	Atherosclerosis	Fibromuscular Dysplasia
Age at presentation	Older (>50 yr)	Usually young (<40 yr)
Sex	Either	Usually female
Lesion location	Ostial, proximal, middle*	Middle or distal
Blood-pressure response to revascularization	Unclear	Normotension in most patients

3. What else might have been in your differential for secondary hypertension? What physical exam findings or labs might help make a diagnosis? (blanks in bold)

Differential Diagnosis	Hx / PE clues:	Screening lab / test
Aldosterone Excess	Hypokalemia, hypernatremia, alkalosis	Plasma aldosterone, renin ratio
Pheochromocytoma: 10% malignant. Assoc with VHL, MEN2, NF1.	HA's, PA's, diaphoresis, undulating. Unusual new onset DM2	plasma free metanephrines (but false +!) vs 24 hr urine
Cushings Syndrome: pituitary adenoma (ACTH independent vs dependent)	HTN, Diabetes, bone-mineral disease, moon faces, central obesity, striae, buffalo hump, weight loss (if ectopic ACTH/malignancy) vs weight gain, hyperpigmentation	Dex-suppression test Late night salivary cortisol Urine free-cortisol excretion
Renovascular hypertension or RAS	Bruit, creatinine increase after ACEi	Renal u/s vs MRA vs CTA
OSA	Snoring, daytime fatigue/somnolence, lower extremity edema (possibly from DD), high mallampti score	OSA questionnaire, sleep study
Alcoholism	Ask about alcohol use	If severe alcoholic, may have electrolyte disturbance usually seen in refeeding (hypomag, hypophos, hypok)

BREAK

OBJECTIVE 3: Differentiate hypertensive urgency from emergency; understand the appropriate treatment and BP goals.

Ms. Franklin is a 23 yo AAF who presented to an ophthalmologist with a one-week history of blurred vision. She was referred to the emergency room. She has no history of smoking or drug abuse and no history of pregnancy. Her only medication is an OCP. Her BP is 210/124 mmHg, HR 100, RR 16 bpm. PE: Chest is clear, heart exam is normal
Labs: Urinalysis by dipstick shows 3+ protein

1. What questions on ROS will you ask? What elements of physical exam would you be sure to perform and why?

- Changes in meds, or abrupt discontinuation?
- Drug use?
- Pregnant?
- BP readings in BOTH arms – r/o dissection
- Fundoscopic exam – looking for papilledema, flame hemorrhages, wool spots
- Lower extremities for swelling – sign of acute heart failure
- Pulses, Bruits
- Mallampati score – OSA contributing? STOPBANG score
- Neuro exam – confusion or encephalopathy (2/2 inability to autoregulate cerebral flow – Syncope AHD throwback)

EKG shows LVH. Urine preg test neg. SCr 1.5mg, eGFR is 58ml/min. Renal US is normal. ANA antibodies negative.

2. What is your diagnosis?

Hypertensive emergency – end organ damage noted with AKI & LVH; also she is symptomatic with blurred vision. See other terms and their proper definitions:

3. How would you treat this patient? (Where is she triaged? What are your BP goals in hypertensive emergency? After stabilization, what do you do next?)

- Most societies/guidelines recommend triage to an ICU with use of antihypertensive gtt with fine titration in the setting of hypertensive emergency
- Reduce MAP by 10-15% in the first hour and then another 10-15% within the next 2-3 hours (total 25% decrease in first few hours). An alternative is to reduce DBP by 10% to 15% or to

HYPERTENSIVE CRISES

Definitions:

- Hypertensive emergency/crisis:** necessitates immediate BP reduction – end organ damage
- Hypertensive urgency:** Severe hypertension with symptoms, reduce BP over hours
- Malignant hypertension:** Severe BP elevation with acute target organ damage, including papilledema
- Accelerated hypertension:** Severe elevation of blood pressure with acute target organ but without papilledema
- Hypertensive encephalopathy:** Sudden, marked elevation of BP with headache or altered mental status, reversible with BP reduction

X = Terms for severity of illness assessment; mostly for billing

approximately 110 mm Hg in 30 to 60 minutes; with a goal reduction to normal within 24 to 48 hours. More drastic drops acutely may result in loss of cerebral autoregulation.

- Choice of medication – Labetalol, Esmolol, Nicardipine, Nitroprusside (see table provided in reading below)
- STOP OCP – establish outpatient plan for contraceptive use (ie depo provera)

4. If her labs were normal and she was asymptomatic (no blurry vision), would you do anything differently?

Yes as this would be **hypertensive urgency** → no end organ damage. The goal would then be to reduce her MAP by NO MORE THAN 25% in the first **24** hours. In addition, oral agents are often adequate to treat hypertensive urgency without requiring an admission.

Table 2. Parenteral Drugs Used for Treatment of Hypertensive Emergencies

Agent	Mechanism of Action	Dose	Onset	Duration of Action	Adverse Effects/Precautions
Sodium nitroprusside	Nitric oxide compound, direct arterial and venous vasodilator	0.25–10 µg/kg/min IV infusion	Immediate	2–3 min after infusion	Nausea, vomiting, Thiocyanate and cyanide intoxication Increased intracranial pressure Methemoglobinemia Delivery sets must be light resistant
Fenoldopam mesylate	Dopamine-1 receptor agonist	0.1–0.3 µg/kg/min IV infusion	< 5 min	30 min	Headache, flushing, tachycardia Local phlebitis Mild tolerance after prolonged infusion May reduce serum potassium ECG changes: nonspecific T-wave changes/ventricular extra systoles
Nitroglycerin	Nitric oxide compound; direct arterial and venodilator (mainly venous)	5–100 µg/min IV infusion	2–5 min	5–10 min	Headache, tachycardia, flushing Methemoglobinemia Requires special delivery system due to drug binding to tubing
Enalaprilat	ACE inhibitor	0.625–2.5 mg every 6 hr IV	Within 30 min	12–24 hr	Acute renal failure in patients with bilateral renal artery stenosis Prolonged half-life
Hydralazine	Direct vasodilation of arterioles with little effect on veins	5–20 mg IV bolus or 10–40 mg IM; repeat every 4–6 hr	10 min IV 20–30 min IM	1–4 hr IV	Tachycardia, flushing, headache Sodium and water retention Increased intracranial pressure Aggravation of angina
Nicardipine	Calcium channel blocker	5–15 mg/hr IV infusion	1–5 min	15–30 min, but may exceed 4 hr after prolonged infusion	Tachycardia, headache, flushing Local phlebitis Aggravation of angina
Esmolol	β-Adrenergic blocker	500 µg/kg bolus injection IV or 50–100 µg/kg/min by infusion. May repeat bolus after 5 min or increase infusion rate to 300 µg/kg/min	1–2 min	10–30 min	Hypotension, nausea Asthma First-degree atrioventricular block Heart failure
Labetalol	α-, β-Adrenergic blocker	20–80 mg IV bolus every 10 min; 0.5–2.0 mg/min IV infusion	5–10 min	3–6 hr	Bronchoconstriction Heart block Vomiting, scalp tingling Heart failure exacerbation
Phentolamine	α-Adrenergic receptor blocker	5–15 mg IV bolus	1–2 min	10–30 min	Tachycardia, flushing, headache

They were asked to complete this handout with their senior. It is now filled in with everything UNLESS bolded – complete the chart.

What about for these specific scenarios? What BP goals? What agents (use table below)?

AORTIC DISSECTION	Rapidly reduce SBP 100 to 120 mmHg within 5- 15minutes - First: IV beta blocker -> reduce velocity/pulsatile load of EF. Esmolol – balanced pharmacokinetic properties. Bolus then gtt. Labetalol can also be used. Bolus then gtt. Goal is to reduce HR \leq 60 bpm. Reduce shear stress on the aortic wall. - Second: Nitroprusside or clevidipine is usually required for arteriolar vasodilation/BP reduction (only if not at goal SBP with BB, do not start with vasodilating agent like nitroprusside because it can cause shear stress before BP reduction is achieved and possibly reflex tachycardia)
ACUTE <u>ISCHEMIC</u> STROKE	Only lower if: - \geq 185/110 mmHg in reperfusion candidate (tPA) - \geq 220/120 mmHg in non-reperfusion candidate Reduce BP by no more than 20% in first 24 h
ACUTE ICH	ONLY treat BP >180/105 mmHg to goal MAP of <130 mmHg in ICH; ICH disrupts autoregulation
HYPERTENSIVE ENCEPHALOPATHY	Lower BP per guidelines of HTN emergency , should see reduction in symptoms after reducing ~15%, if not suspect other causes of symptoms. This is essentially a diagnosis of exclusion.
PREGNANCY	Goal BP <160/100 mmHg Goal BP <140/90 mmHg if end organ damage Magnesium Sulfate – seizure ppx (avoid with CCB) Methyldopa Labetalol – 1 st line - Rapid onset & good safety profile Nicardipine IV gtt Do not use IR nifedipine (CCB) PO/SL – acute precipitous falls (CVA & MI) Hydralazine - has been used but falling out of favor because can also cause rapid drop in BP
ACUTE PULMONARY EDEMA	BP goals similar to hypertensive emergency. DIURESE + AFTERLOAD REDUCTION Furosemide for diuresis (bolus +/- gtt) then afterload reduction – IV ACEi (enalaprilat) or nitroprusside (preload & afterload reducing), or Nitroglycerin (preload) → Preload reduction: reduces pulmonary venous return, decreases pulmonary capillary hydrostatic pressure, reduces fluid transudation into pulmonary interstitium and alveoli → Afterload reduction: reduces SVR → increases CO, improves renal perfusion, promoting diuresis
ACUTE MI or INFARCT	Improve coronary flow, reduce ischemia, reduce afterload BB if not in decompensated HF (see first box for BB options) + nitroglycerin for chest pain, vasodilation
ACUTE RENAL FAIL	Fenoldopam (dopamine -1 agonist) or nicardipine
HYPERADRENERGIC STATE, SYMPATHETIC CRISIS	Pheochromocytoma – phentolamine, nitroprusside , can use BB AFTER alpha blockade is achieved – pre-operatively treat with Phenoxybenzamine 7-10d, IVF with normal saline morning of, will add BB and use through day after surgery <u>Clonidine or BB withdrawal</u> - resume PO agents – may not need to use IV therapy if no evidence of organ damage (if urgency not emergency) – discuss adherence with patient given risk of rebound

	<p>hypertension – consider taper to another agent in hospital prior to discharge</p> <p><u>Cocaine intoxication</u> – labetolol can be used because it is both alpha and beta blocking – avoid pure B1 blockade, DHP CCB (nicardipine) and BZD; can use verapamil or dilt (non DHP)</p>
<p>ACUTE POSTOPERATIVE HYPERTENSION</p>	<p>Control pain</p> <p>Check for urinary retention, constipation.</p> <p>Goal BP if post- cardiothoracic surgery MAP <105 mmHg or \leq140/90</p> <p>Nicardipine, Labetolol favorable</p>