

## CASES:

How would you respond to each of the following clinical scenarios?

- 1) You are called to see a 35 year-old woman on the Ortho Service to help evaluate a BP of 168/104. She was admitted 48 hours earlier following an MVA and required surgery to stabilize multiple fractures. She had no previous medical problems.
  - 2) A 24 year-old man is admitted to the ICU with a severe asthma exacerbation. The BP is 180/120. He has no prior history of HTN.
  - 3) A 36 year-old is admitted with headache, blurred vision, shortness of breath, and dark urine of 2 days' duration. The blood pressure is 220/122. Retinal hemorrhages are present. Rales are heard in the dependent half of the chest. The JVP is elevated to the angle of the jaw and an S3 is heard.
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## An Approach to the Management of Elevated Blood Pressures (BP) in the Hospital

*John Sheffield, MD*

*Erin Sutcliffe, MD*

*Harborview Medical Center*

Goals of Inpatient Blood Pressure Management:

1. Identify and treat underlying causes
2. Prevent acute end-organ damage

### Common Causes of Hypertension in Hospital

- Problems with administration of antihypertensive therapies:
  - a) rebound if central agents or beta-blockers are withheld
  - b) improper dosing
  - c) drug interactions:
    - rifampin increases clearance of beta blockers and verapamil;
    - antacids may reduce the absorption of ACE inhibitors and diuretics
- Treatment with corticosteroids, NSAIDs, sympathomimetics, erythropoietin, cyclosporine
- Volume overload
- Alcohol withdrawal
- Acute renal failure
- Hypoxemia or respiratory distress
- Elevated intracranial pressure
- Pain or anxiety
- Autonomic responses: bladder distension, constipation, hypoglycemia, spinal cord injury

### Approach to Evaluating the Hypertensive Inpatient

1. Determine patient's baseline BP
2. Confirm accuracy of measurement (confirm yourself)
3. Confirm both arms, verify correct cuff size
4. Review medications carefully
5. Screen for common causes of BP elevation in hospital
6. Determine whether hypertensive emergency or urgency is present

### Key Points in History

- Usual BP
- If HTN a longstanding problem: usual treatment and degree of control achieved
- Symptoms of acute end-organ damage: chest pain, dyspnea, headache, blurred vision, diminished level of consciousness, decreased urine output

- "Is anything else going on?:" i.e. pain, anxiety, status of medical problems leading to admission
- Alcohol use
- Current medications

### Physical Examination

- Vitals: measure BP yourself, both arms
- Retina: papilledema
- Chest: rales, wheezing
- CV: JVP, LV enlargement, rhythm, gallops, murmurs, pulses, bruits
- Abdomen: aorta, masses
- Extremities: perfusion, edema
- Neurologic: mental status, tremor, evidence of stroke
- Follow Up

### Laboratory Studies

- As needed for evaluation of underlying condition
- Specific "hypertension labs" required **only** if acute end-organ damage suspected: chemistry panel, urinalysis, ECG, CXR

### Drug Treatment Principles

- Treat underlying conditions first:
  - ETOH withdrawal: give enough benzodiazepines to render patient calm but awake
  - Acute coronary syndrome: oxygen, ASA, heparin, nitrates, morphine, beta blockers, statin
  - Congestive heart failure: diuretics, morphine, ACE inhibitors, nitrates
  - Pain: opiates if not contraindicated (avoid NSAIDs)
  - Anxiety: reassurance or benzodiazepines
  - Volume overload: diuretics (or dialysis as indicated)
  - Asthma or COPD: treat obstruction with steroids and bronchodilators. **Avoid antihypertensives.**
- Elevated blood pressure alone rarely requires immediate treatment, especially in the middle of the night. Specific antihypertensive treatment should be initiated immediately only for hypertensive emergencies or urgencies.
- Avoid PRN use of rapid-acting agents (esp. nifedipine) due to unpredictable effects on BP and possible precipitation of ischemic events.
- For patients with sustained HTN, it is preferable to institute a long-term regimen than respond to occasional BP rises with PRN medication (e.g., nitropaste, hydralazine, clonidine, etc.)
- Decisions regarding long-term antihypertensive therapy should be made by the patient's primary team in consultation with the primary care physician.

### Hypertensive Urgency

- Definition: severe HTN (DBP > 120) without acute or ongoing end-organ damage
- Example: severe HTN without papilledema or progressive target organ complications
- Patients at risk: patients with chronic HTN who stop their medicines, or, for any of a number of reasons, develop an abrupt rise in angiotensin II and norepinephrine levels.
- Treatment goal: Gradual reduction in BP to 160/110 over 24-48 hours.
- Suggested treatment: oral agents with relatively rapid onset of action.
  - Furosemide 20 mg (higher dose needed if renal failure present)
  - Amlodipine 5 mg qd
  - Captopril 12.5 mg bid-tid (Max dose: ~200 mg/d)
  - Labetalol 100 mg bid (Max dose: 800 mg/d)

Propranolol 40 mg bid (Max dose: 640 mg/d)

OR for patients with chronic HTN whose treatment has been interrupted, resume prior regimen.

- Monitoring: frequent BP checks over 3-6 hours to confirm reduction. Clinic follow-up within 7 days.

### Hypertensive Emergency

- Definition: Severe HTN with acute or ongoing end-organ damage. Symptoms may develop at lower blood pressures (DBP >100) in previously normotensive patients with eclampsia or acute glomerulonephritis (GN)
- Examples:
  - Malignant HTN
    - Papilledema
    - Nephrosclerosis (renal failure, proteinuria, hematuria)
    - Encephalopathy (headache, nausea/vomiting, confusion, non-focal neuro exam)
  - Acute coronary syndrome
  - Acute left ventricular failure
  - Acute GN or severe renal parenchymal disease (Hemolytic Uremic Syndrome, vasculitis, etc.)
  - Aortic dissection
  - Excessive catecholamines
    - Cocaine or PCP overdose
    - Pheochromocytoma
    - Rebound HTN after cessation of clonidine or beta-blocker
    - Spinal cord injury
  - Eclampsia
  - Severe HTN in patient requiring immediate surgery
  - Acute stroke (ischemic, SAH, ICH) – **Note: treatment may be different**
- Treatment goal: Smooth, immediate 15-25% reduction in DBP to 100-110.
- Suggested treatment: parenteral agents (see table). Avoid oral agents (esp. sublingual nifedipine) due to slower onset of action and unpredictable degree of reduction that may precipitate ischemic events. Once BP controlled, switch to oral therapy with goal to reduce DBP to 85 over 2-3 months.
- Monitoring: Arterial catheter in ICU. Pay careful attention to central nervous system, renal and cardiac function as BP falls.

### Treatment of Specific Hypertensive Emergencies

- Acute pulmonary edema: nitroprusside or nitroglycerin plus loop diuretic
- Acute coronary syndrome: nitroglycerin, beta-blockers, ACE inhibitors
- Aortic dissection: nitroprusside **plus** beta-blocker
- Severe hypertension in patient requiring immediate surgery: beta-blockers (goal HR = 60)
- Withdrawal of antihypertensive therapy: resume usual regimen. Others if necessary.
- Excessive catecholamines: nitroprusside or labetalol
- Eclampsia: Hydralazine, nifedipine, or labetalol. Nitroprusside and ACE inhibitors contraindicated
- Ischemic stroke, subarachnoid hemorrhage, intracranial hemorrhage: uncertain. BP reduction may worsen ischemic damage.

### Case Follow-ups:

- 1) Her elevated BP is due to pain and the treatment for her hypertension is to treat her pain aggressively with opiates if not contraindicated; avoid NSAIDs.

- 2) His elevated BP is due to his pulmonary condition and respiratory distress. The treatment for his hypertension is to treat the pulmonary obstruction with steroids and bronchodilators. **Avoid antihypertensives**
- 3) This is a patient with hypertensive emergency as evidenced by signs of end-organ damage including blurred vision, renal insufficiency, and signs of heart failure. He should be placed in the ICU and parenteral agents should be instituted.

#### Clinical Pearls

- o Most inpatients with elevated blood pressure have it due to another underlying problem and the best management is to treat that underlying illness
- o Screen for signs of urgency/emergency such as end-organ damage (headache, chest pain, hematuria, vision changes) -> changes management!

#### References

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#### Parenteral Antihypertensive Agents for Hypertensive Crisis

Drug	Class	Indication	Dose	Onset	Duration	Considerations
<i>Enalaprilat</i>	ACE inhibitor/vasodilator preload/afterload reducer	hypertensive emergency	1.25-5mg IV every 6 h	15-30 min	6 h	Contraindicated in pregnancy
<i>Esmolol</i>	B-selective adrenergic blocking agent	hypertensive emergency/post-operative HTN; acute coronary syndrome Acute aortic dissection	200-500ug/kg/min for 4min, then 50-300ug/kg/min IV	1-2 min	10-20 min	Not to be used as single agent for acute sympathetic increase due to unopposed alpha vasoconstriction
<i>Fenoldopam</i>	peripherally acting vasodilator specific for D1 receptor(agonist)	hypertensive emergency in: acute renal failure, pulmonary edema, hypertensive encephalopathy	0.1-0.3ug/kg/min IV	<5 min	30 min	10 X more potent than dopamine as renal vasodilator
<i>Hydralazine</i>	arterial vasodilator	hypertensive urgency; drug of choice for eclampsia	10-20mg IV 10-50mg IM q 3-6h eclampsia:5-10mg q 20 min	10-20 min/20-30min	3-8 h	May result in precipitous fall in BP (may last for up to 12 h) Avoid in hypertensive emergencies

<i>Labetalol</i>	alpha/beta adrenergic blocking agent	hypertensive emergency in: acute coronary syndrome; acute aortic dissection; eclampsia; pheochromocytoma	20-80mg IV bolus q 10 min; 0.5-2mg/min infusion	5-10 min	3-6 h	IV alpha/beta blocking ratio 1:7
<i>Nicardipine</i>	calcium channel blocker (dihydropyridine)	hypertensive emergency; eclampsia; acute renal failure; hypertensive encephalopathy,	Initial dose 5mg/hr IV then increase by 2.5mg/hr q15min	5-15 min	4-6 h	Use with caution in CHF patients
<i>Nitroglycerin</i>	venodilator; vasodilator at high doses only	hypertensive emergency; acute pulmonary edema, acute coronary syndrome	5 ug/min IV max dose 100ug/min tolerance may develop if administered for 12-24 hrs	1-5 min	5-10 min	Add loop diuretic in acute pulmonary edema
<i>Nitroprusside</i>	arterial/venous vasodilator, preload/afterload reducer	hypertensive emergency; acute pulmonary edema, acute aortic dissection(with esmolol), acute increase in sympathetic activity	0.25-10 ug/kg per minute IV; max dose for 10 minutes only	Immediate	1-2 min	Contraindicated in pregnancy-toxic to fetus, possible cyanide toxicity Use only in patients with normal renal and hepatic function

*\*Prepared by Jan Kay, R.Ph., UMC Pharmacy Department*

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