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OBJECTIVES:

1. Describe the scope of hypertension in the emergency department.
2. Describe the various emergent presentations of hypertension.
3. Describe the various disease entities associated with hypertension and associated specific treatment regimens.

INTRODUCTION

Hypertension is the most common outpatient diagnosis in the United States, accounting for over 37 million outpatient visits in 2004.¹ Almost 30% of ambulatory visits include a diagnosis of hypertension.² It is more common in older age groups, in males, and in African Americans.²


Hypertension is an independent risk factor for myocardial infarction, heart failure, stroke, and renal disease. Treatment of elevated blood pressure reduces the likelihood of developing these sequelae (Table 1).³ This recognition has led to a recent increase in hypertension control rates; however, the prevalence has remained the same.

The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) divides hypertension into three groupings: pre-hypertension, stage 1 hypertension, and stage 2 hypertension, and uses these categories to guide therapy (Table 2).⁴ These guidelines recommend repeating blood pressure measurements on two separate occasions prior to the diagnosis of hypertension. This recommendation, however,

is not practical for diagnosis and risk stratification in the emergency department (ED). Over 30% of patients presenting to the ED have an elevated blood pressure (>140/90).⁵ Studies have shown that 20% to 70% of patients with an increased blood pressure in the ED subsequently have an elevated blood pressure in the outpatient setting.⁶⁻⁹

Pathophysiology

Blood pressure is regulated by the cardiovascular, renal, endocrine, and central nervous systems. In turn, blood pressure also affects these systems. Blood pressure is the primary determinant of tensile stress in arteries. Chronic elevation of blood pressure leads to vascular remodeling with resultant thickening and sclerosis of vessel walls. The sclerotic changes enhance the shearing force in the vessel, further contributing to vessel damage. In addition, the endothelium secretes nitric oxide, prostacyclin, and endothelin which modulate vascular tone. Prolonged vasoconstriction leads to endothelial dysfunction, loss of nitric oxide production, and irreversible rise in peripheral arterial resistance. Inflammatory cytokine release leads to increasing endothelial permeability, decreased fibrinolysis, and increased coagulation.¹⁰



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Table 1. End organ damage associated with hypertensive emergencies

End organ damage type	Cases (%)
Cerebral infarction	24.5
Hypertensive encephalopathy	16.3
Acute decompensated heart failure	14.3
Acute coronary syndromes	12.0
Intracerebral or subarachnoid hemorrhage	4.5
Aortic dissection	2.0

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Table 2. JNC-7 classification of hypertension

Class	Systolic BP		Diastolic BP
Normal	<120	and	<80
Pre-hypertension	120-139	or	80-89
Stage 1	140-159	or	90-99
Stage 2	160 or higher	or	100 or higher

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The renin-angiotensin-aldosterone system contributes to blood pressure regulation. Renin is released from the kidneys in response to under perfusion of the kidney and low sodium intake. This leads to activation of angiotensin II, a potent vasoconstrictor, and subsequently increases blood pressure. Angiotensin II also causes aldosterone release, which further increases blood pressure.¹¹ Persistent stimulation of the renin-angiotensin-aldosterone axis may result in a rise in creatinine, hypokalemic metabolic alkalosis, hematuria and proteinuria. With renal end organ damage due to hypertension, the kidneys will demonstrate glomerular ischemia, and reiterative endarteritis with capillary and arteriolar necrosis.¹²

An imbalance in sympathetic tone and parasympathetic response can result in increased cardiac output and arterial vasoconstriction.¹³ Patients with chronic hypertension may experience decreased cerebral blood flow and subsequent cerebral ischemia if blood pressure is lowered rapidly.¹⁴⁻¹⁶ Conversely, a rapid rise in blood pressure can cause the classic triad of hypertensive encephalopathy: hypertension, altered mental status and papilledema.¹⁷ Chronic hypertension also affects the heart by increasing left ventricular mass, which may result in decreased coronary perfusion pressure, increased myocardial oxygen consumption, and subsequent myocardial ischemia.

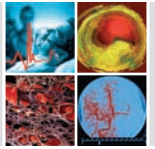
History and Physical Examination

The history and physical examination should be focused on evaluation of possible end organ damage. The history should include medication use as well as any recreational drug use which may be a secondary cause of hypertension. Complaints of chest pain should lead to evaluation for possible acute coronary syndrome (ACS) and aortic dissection. Sudden onset of headache may suggest subarachnoid hemorrhage. Shortness of breath should lead to evaluation of heart failure. The physical examination should include auscultation of the lungs for evidence of pulmonary edema, and the heart for murmurs or gallops. The neurological examination should focus on lateralizing signs which may suggest a stroke.^{10, 11} In the setting of severe hypertension, there is the potential for disruption of the blood-retina barrier, necrosis, retinal ischemia and optic disk edema with hemorrhage, ‘cotton wool spots’, and papilledema on fundoscopic examination. Retinopathy suggests concurrent vascular disease in the cerebral arterioles, thereby increasing the risk of all vascular complications.¹⁸

Asymptomatic Hypertension

Most patients with hypertension in the ED will be asymptomatic. Hypertension is a risk factor for many urgent or emergent conditions including subarachnoid hemorrhage, ischemic and hemorrhagic stroke, aortic dissection, heart failure, and ACS. Unless there are signs of acute end organ damage, or the patient is known to already carry the diagnosis of hypertension, the American College of Emergency Physicians (ACEP) Practice Guidelines do not recommend the routine initiation of anti-hypertensive medications in the ED.⁶

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Asymptomatic patients with pre-hypertension or stage 1 hypertension and a normal physical examination should be referred for a blood pressure re-check. The ACEP guidelines note other association guidelines similarly do not recommend using intravenous agents to acutely lower blood pressure. The goal is not to normalize blood pressure during the ED visit.⁶

Above a systolic blood pressure of 210 mm Hg or a diastolic of 120 mm Hg, it is reasonable to initiate oral anti-hypertensive medications (Table 3) and recommend early follow up. If a patient needs to be started on an anti-hypertensive agent, the physician should obtain electrolytes and a creatinine level prior to starting medication and refer the patient for timely outpatient follow up.

Table 3. The therapeutic options for individual drugs based on the underlying condition of the patient (From JAMA 2003;289:2560-2572)

Concurrent conditions	Initial therapy options
Heart failure	THIAZ, BB, ACEI, ARB, ALDO ANT
Post myocardial infarction	BB, ACEI, ALDO ANT
High CVD risk	THIAZ, BB, ACEI, CCD
Diabetes	THIAZ, BB, ACEI, ARB, CCD
Chronic kidney disease	ACEI, ARB

Abbreviations: ACEI, angiotensin converting enzyme inhibitor; ALDO ANT, aldosterone antagonist; ARB, angiotensin receptor blocker; BB, β -blocker; CCB, calcium channel blocker; THIAZ, thiazide.

Acute Coronary Syndrome

The objective in treatment of hypertension in patients with an acute coronary syndrome (ACS) is reduction of ischemic symptoms. The treatment of hypertension in the setting of an ACS may require multiple agents. In the ACC/AHA guidelines for ST-segment elevation myocardial infarction (MI), both nitroglycerin and beta-blockers are a Class I recommendation. In patients with ongoing symptoms, calcium channel blockers are a class IIa recommendation. For patients with ST-segment elevation MI, the use of fibrinolytics is contraindicated if the blood pressure is greater than 185/100mm Hg.¹⁹

In the American College of Cardiology (ACC)/American Heart Association (AHA) guidelines for unstable angina/non ST-segment elevation MI, several medications received a Class I recommendation for treatment. Nitroglycerin is the first line agent which lowers blood pressure and reduces ischemic symptoms. For continuing symptoms, the guidelines recommend a beta-blocker, followed by a nondihydropyridine calcium antagonist if necessary. An ACE inhibitor is recommended in patients with ongoing symptoms despite initial treatment if the patient has known left ventricular dysfunction, heart failure or diabetes.²⁰

Acute Heart Failure Syndromes

Patients with acute heart failure syndromes (AHFS) often present with elevated blood pressure. Those with acute symptoms should be stratified according to their initial blood pressure and treatment based upon this stratification.²¹ Treatment for patients with elevated systolic blood pressure (>140 mm Hg) has focused on the use of vasodilators. The European Society of Cardiology (ESC) recommends nitroglycerin or other vasodilators as the first line treatment for ADHF (Class I, Level B).²² Nitroprusside or intravenous angiotensin converting enzyme inhibitors are also options.^{22,23} Blood pressures should not be normalized, but instead, lowered by 30mm Hg. If this cannot be achieved through diuretics and vasodilators, the ESC recommends a calcium channel blocker. Research is currently underway to define the role of agents such as vasopressin antagonist, adenosine antagonist, endothelin antagonists, and ularitide as potential treatment options for this group of patients.²¹

Neurological Emergencies

In the setting of acute ischemic stroke, aggressive lowering of blood pressure can reduce perfusion, expanding the zone of infarction. This is well documented with sublingual nifedipine, which should never be used to rapidly reduce blood pressure.²⁴ The only clear indications for blood pressure reduction in stroke are for patients being treated with fibrinolysis for ischemic stroke and for patients with hemorrhagic stroke. In these populations, elevated blood pressure significantly increases the risk of intracerebral hemorrhage and hemorrhage expansion. Fibrinolytic therapy should not be given to patients who have a systolic



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blood pressure >185 mmHg or a diastolic blood pressure >110 mmHg at the time of treatment.^{25,26} When treated with a fibrinolytic agent, patients should have blood pressure maintained at less than 180/105 for 24 hours.²⁶

In intracerebral hemorrhage, blood pressure should be controlled to maintain cerebral perfusion pressure. It is reasonable to maintain mean arterial pressure (MAP) below 130 mm Hg, or systolic blood pressure below 180 mm Hg, for the first 24 hours following symptom onset. In patients with elevation in intracranial pressure, MAP should be maintained below 110 mm Hg, or systolic blood pressure below 160 mm Hg, for the first 24 hours following symptom onset. It is recommended that patients who have undergone craniotomy, the MAP should be maintained under 100 mm Hg; ideally these patients will no longer be in the ED. In all cases, MAP should be maintained above 90 mm Hg, and the cerebral perfusion pressure should be maintained above 70 mm Hg.²⁷ When the clinician determines blood pressure lowering is required for intracerebral hemorrhage, the preferred agents are labetalol, nicardipine and esmolol.

Patients with an ischemic stroke who have concurrent evidence of end organ damage, for example acute myocardial infarction, aortic dissection, hypertensive encephalopathy, acute renal failure, and acute pulmonary edema, or patients with extremes of blood pressure the clinician feels compelled to treat, are best treated with labetalol or nicardipine.²⁴

Blood pressure control is vital in subarachnoid hemorrhage (SAH). There is a linear relationship between early re-bleeding and increasing SBP above 160 mm Hg.²⁸ Currently, most physicians caring for aneurysmal SAH treat elevated blood pressure when the patient's MAP is above 130 and try to maintain the SBP below 160 mm Hg. Oral nimodipine is used in patients with aneurysmal SAH to prevent delayed ischemic neurological deficits. Nimodipine may have a hypotensive effect, but is not the preferred agent for treatment of hypertension. Prior to treatment with any antihypertensive agent, pain control and sedation should be addressed and blood pressure should then be reassessed. When blood pressure lowering is required for SAH, the preferred agents are labetalol, nicardipine and esmolol.²⁸

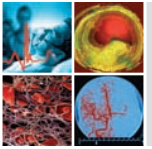
Cocaine or Amphetamine Induced Hypertension

Sympathomimetic agents can induce hypertension. The ED approach to the patient with cocaine intoxication is analogous to that of the patient with hypertension. There are, however, some important differences. Asymptomatic patients do not require treatment because the half life of the sympathomimetic agents is short and the stimulus for hypertension will resolve in several hours. When patients are agitated or require treatment for potential end organ damage, benzodiazepines are recommended. These agents will usually reduce the blood pressure and heart rate. When sedation is unsuccessful and the patient has hypertension which warrants treatment, sublingual or intravenous nitroglycerin, or intravenous phentolamine can be given.²⁹⁻³⁴ Beta blockade is contraindicated because it results in an unopposed alpha-adrenergic effect, leading to vasoconstriction and a paradoxical increase in blood pressure.³⁵⁻³⁷

Aortic Dissection

Chronic hypertension affects arterial wall composition, causing thickening, calcification, fibrosis and fatty acid deposition. The vessel wall becomes vulnerable to pulsatile forces which can cause an intimal tear creating a false lumen.³⁸ Because acute aortic dissection involving the ascending thoracic aorta or aortic arch (Stanford type A) is also a surgical emergency,³⁸ the treatment of hypertension in these patients must anticipate surgical considerations. A recent review recommended blood pressure control with a target systolic blood pressure of 110 mm Hg achieved using a combination of narcotic analgesics, intravenous beta-blockers, and vasodilating drugs such as sodium nitroprusside.³⁹ This antihypertensive regimen was consistent with the recommendations of the ESC Task Force on Aortic Dissection recommending pain relief using morphine sulfate, reduction of systolic blood pressure using beta-blockers including intravenous propranolol, metoprolol, esmolol, or labetalol, and the addition of a vasodilator such as sodium nitroprusside to achieve a systolic blood pressure in the range of 100 to 120 mm Hg.⁴⁰ Verapamil or diltiazem is recommended as an alternative therapy in patients with potential intolerance to beta blockers.^{39,40}

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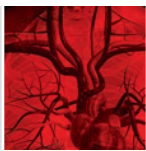


SUMMARY

Hypertension is an extremely common presentation for patients in the emergency setting. In asymptomatic patients, it is usually not necessary to treat, but instead to recommend follow up as an outpatient. Hypertension is a significant risk factor for many of the urgent conditions seen in the ED, including SAH, ischemic and hemorrhagic stroke, aortic dissection, heart failure, and ACS. These patients may need aggressive management of their blood pressure to decrease end organ damage. The appropriate therapeutic approach depends on the clinical presentation and condition of the patient.

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