Chapter

# 57 Hypertensive Emergencies

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## ARTERIAL HYPERTENSION

Arterial Hypertension is a medical condition where the blood pressure is chronically elevated[1]. Persistent hypertension is one of the risk factors for stroke, heart attack and heart failure, and is a leading cause of chronic renal failure.

## DEFINITION

Blood pressure is a continuous variable, and risks of various adverse outcomes rise with it. "Hypertension" is usually diagnosed on finding blood pressure above 140/90 mmHg measured on both arms on three occasions over a few weeks. Recently, the JNC VII (The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure)[2] has defined blood pressure over 120/80 mmHg and below 140/90 mmHg as "pre-hypertension". "Prehypertension is not a disease category. Rather, it is a designation chosen to identify individuals at high risk of developing hypertension (JNC VII)." Normal blood pressure is 120/80 mmHg. In patients with diabetes mellitus or kidney disease, studies have shown that blood pressure over 130/80 mmHg should be considered a risk factor and may warrant treatment.

## HYPERTENSIVE EMERGENCIES

Hypertensive Emergency, also called Hypertensive Crisis, is severe hypertension with acute impairment of an organ system, e.g., central nervous system (CNS) cardiovascular and/or renal, requiring substantial reduction of blood pressure within one hour to avoid the risk of serious morbidity and death. Blood pressure is often severely raised, diastolic >130 mmHg but is always a poor correlation between pressure and end-organ damage. Seriousness of hypertensive emergency and approach to treatment is determined by end organ damage. While at the same time hypertensive urgency is characterized by a lack of end organ damage. Hypertensive emergencies are associated with the following:

- Neurological deficits primarily presenting as TIA, hypertensive encephalopathy, intracranial hemorrhage and stroke.
- Cardiovascular complications such as pulmonary edema, acute myocardial infarction, adrenergic crisis, dissecting aortic aneurysm, and eclampsia.
- Renal complications as hematuria and progressive renal dysfunction.

In these conditions, the blood pressure (BP) should be lowered aggressively over minutes to hours.

### Hypertensive Urgency

This is distinguished from hypertensive emergency, in which the BP is a potential risk but has not yet caused acute end-organ damage. Hypertensive crisis is defined as having a diastolic BP greater than 120 mmHg that persists after a period of observation and has optic disk edema, progressive target organ complication, and severe perioperative hypertension. These patients require BP control over several days to weeks. Hypertensive urgencies are associated with the following: malignant hypertension, left ventricular failure, unstable angina, perioperative hypertension and pre-eclampsia.

### Severe Hypertension

The third category, severe hypertension, is elevated BP not yet leading to significant organ damage. In these patients, the hypertension does not necessarily require treatment during the emergency visit but does require close follow-up with a primary care physician for long-term BP control. In these cases, beginning antihypertensive therapy in the emergency may be appropriate.

### Emergency Department Considerations

Optimal control of hypertensive situations balances the benefits of immediate decrease in BP against the risk of significant decrease in end-organ perfusion. The emergency physician must be capable of the following:

- Appropriately evaluating patients with an elevated BP.
- Correctly classifying the hypertension.
- Determining the aggressiveness and timing of therapeutic interventions.

An important point to remember in the management of the patient with any degree of BP elevation is to "treat the patient and not the number".

### Pathophysiology

The three major organ systems affected by high BP are the central nervous system, cardiovascular system, and renal system.

#### *Central Nervous System*

The CNS is affected as the elevated BP overwhelms the normal cerebral autoregulation. Under normal circumstances, with an increase in BP, cerebral arterioles vasoconstrict and cerebral blood flow (CBF) remains constant. During a hypertensive emergency, the elevated BP overwhelms arteriolar control over vasoconstriction and autoregulation of CBF. This results in transudate leak across capillaries and continued arteriolar damage. Subsequent fibrinoid necrosis causes normal autoregulatory mechanisms to fail, leading to clinically apparent papilledema, the sine qua non of malignant hypertension. The end result of loss of autoregulation is hypertensive encephalopathy.

#### *Cardiovascular System*

The cardiovascular system is affected as increased cardiac workload leads to cardiac failure; this is accompanied by pulmonary edema, myocardial ischemia, or myocardial infarction.

#### *Renal System*

The renal system is impaired when high BP leads to arteriosclerosis, fibrinoid necrosis, and an overall impairment of renal protective autoregulation mechanisms. This may manifest as worsening renal function, hematuria, red blood cell (RBC) cast formation, and / or proteinuria.

Hypertensive emergencies and urgencies occur in less than 1% of the 60 million people with hypertension. Even though not many people with hypertension experience hypertensive crisis, there are still a significant number of events since so many people have hypertension.

### Frequency

- **In the US:** More than 60 million Americans, about 25 to 30% of the population, have hypertension. Of these individuals, 70% have mild disease, 20% moderate, and 10% severe hypertension – diastolic BP (DBP) >110 mmHg. Approximately 1-2% develop a hypertensive emergency with end-organ damage.

### Morbidity/ Mortality

Morbidity and mortality depend on the extent of end-organ damage on presentation and the degree to which BP is controlled subsequently. BP control may prevent progression to end-organ impairment.

- One-year mortality rate for an untreated hypertensive emergency is greater than 90%.
- Five-year survival rate among all patients presenting with a hypertensive crisis is 74%.

***Race:*** African Americans have a higher incidence of hypertensive emergencies than Caucasians[3].

***Sex:*** Males are at greater risk of hypertensive emergencies than females.

***Age:*** Hypertensive emergencies occur most commonly in middle-aged patients. The peak incidence occurs in those aged 40 to 50 years[4].

### Etiological Causes of Hypertensive Emergencies

#### *Essential Hypertension*

*Renal*

Renal artery stenosis

Glomerulonephritis

*Vascular*

Vasculitis (hemolytic uremic syndrome, thrombotic thrombocytopenic purpura)

*Pregnancy Related*

Preeclampsia

Eclampsia

*Pharmacological*

Sympathomimetics

Clonidine, beta blocker withdrawal

Cocaine

Amphetamines

*Endocrine*

Cushing syndrome

Conn's syndrome

Pheochromocytoma

Rennin secreting adenoma

Thyrotoxicosis

*Neurologic*

Intracranial

Autoimmune

*Scleroderma Renal Crisis.*

### Treatment

IV vasodilator therapy to achieve a decrease in mean arterial pressure (MAP) of 20 to 25% or a decrease in diastolic blood pressure (DBP) to 100 mmHg to 110 mmHg in the first 2 hours is recommended[5]. Decreasing the MAP / DBP further should be done more slowly, as one risks decreasing perfusion of end-organs[6]. Several drugs have proved beneficial in achieving this goal.

#### *Prehospital Care*

- Address the manifestations of a hypertensive emergency, such as chest pain or heart failure. Reduction of BP may not be indicated in the prehospital setting[7].
- Oxygen, frusemide and nitrates may be appropriate.
- Under most circumstances, attempting to treat hypertension directly in the prehospital setting is unwise, as rapid lowering of BP can critically decrease end-organ perfusion[8].

#### *Emergency Department Care*

The fundamental principle in determining the necessary emergency care of the hypertensive patient is the presence or absence of end-organ damage.

- Initial considerations (if the patient is not in distress)
  - — Patient in distress should be counseled after an initial interview. In one study, 27% of patients with an initial DBP >130 mm Hg had their DBP fall below critical levels after relaxation without specific treatment[6].
  - — Consider the context of the elevated BP (e.g., severe pain often causes increase in BP).
- Screen for end-organ damage
  - — Use historical criteria, physical examination steps, lab studies, and diagnostic tests to evaluate for cause of hypertension[6].
  - — Patients with end-organ damage usually require admission and rapid lowering of BP using intravenous (IV) medications. Suggested medication depends on the affected organ system.
  - — Patients without evidence of end-organ effects may be discharged with follow-up:
    - ■ The misconception remains that a patient never should be discharged from the ED with elevated BP[9]. As a result of this belief, patients are given oral medicines, such as nifedipine, in an effort to lower BP rapidly before discharge. This is not indicated and may be dangerous[10].
    - ■ Attempts to temporarily lower BP by using these medicines may result in a precipitous and difficult-to-correct drop in BP. Should this occur, end-organ hypo-perfusion may result. Furthermore, patients who present with high BP may have had this elevation for some time and may need chronic BP control but may not tolerate rapid return of BP to a "normal" level.
    - ■ Acute lowering of BP in the narrow window of the ED visit does not necessarily improve long-term morbidity and mortality rates[11]. Rapid BP reduction is indicated in the following circumstances with IV medication[12]:
  - — Acute myocardial ischemia
    - ■ Nitroglycerin
    - ■ Beta-blockers
    - ■ Angiotensin-converting enzyme (ACE) inhibitors (if available).
  - — CHF with pulmonary edema
    - ■ Nitroglycerin
    - ■ Frusemide
    - ■ Morphine.
  - — Acute aortic dissection
    - ■ Nitroprusside IV plus beta-blockers
    - ■ Alternative-Trimethaphan plus beta-blockers.

— Cerebral vascular accident: Lowering BP is indicated in cardiac or renal compromise, DBP >130 mmHg, hypertensive encephalopathy, or subarachnoid hemorrhage (may require BP control to prevent rebleeding even without other evidence of end-organ damage)[13].
  - Nitroprusside
  - Labetalol
  - Nimodipine.

- Reduce BP quickly (over minutes to hours) in the following settings[14]:
  — Pheochromocytoma
    - Phentolamine
    - Nitroprusside
    - Labetalol.
  — Hypertensive encephalopathy
    - Nitroprusside
    - Trimethaphan
    - Beta-blockers.
  — Eclampsia
    - Hydralazine
    - Labetalol
    - Magnesium IV.

## INTRAVENOUS DRUGS

### *Sodium Nitroprusside*

- Standard rapidly acting agent effective in many cases.
- Dose is 0.25-8 µg/kg/minute as IV infusion, start with 0.3-0.5 ug/kg/min (about 20 to 50 ug/min), then 1 to 3 ug/kg/min IV (max:<10 ug/kg/min) (50 mg in 250 ml D5W).
- Onset: 0.5-1 min; Duration: 2 to 5 min.
- Adverse effects: hypotension, N and V, apprehension, cyanide (thiocyanate level >10 mg/dl is toxic; >20 mg/dl may be fatal) toxicity convulsion, twitching, psychosis, dizziness, etc.
- Nitroprusside has decreased efficacy in renal failure.
- Toxic levels of cyanide build up rapidly in patients with renal failure.
- Nausea, vomiting, muscle twitching and sweating can occur.

### *Nitroglycerin*

- Highly effective in setting of coronary ischemia, acute coronary syndromes
- Dose is 5 to 100 µg/min as IV infusion Nitroglycerin IV infusion should be started 5 to 10 ug/min then may be increased up to >200 ug/min especially in patients where sodium nitroprusside is relatively contraindicated and in patients with ischemic heart disease, impaired renal or hepatic function.
  — Onset: immediate; Duration: 1 to 5 min.
- May cause headache, tachycardia, vomiting, methemoglobinemia.
- Excellent for titrating blood pressure in setting of coronary ischemia.

### *Labetalol*

- Mixed alpha/beta blocker, excellent for most hypertensive emergencies
- Dose is 20-80 mg IV bolus every 10 minutes or 0.5 to 2 mg/min infusion IV Start 20 mg IV, then 20-80 mg q10 min prn, or start with 0.5 mg/min infusion, then 1 to 2 mg/min (may be up to 4 mg/min) IV infusion up to 300 mg/d max.
  — Onset: 5 to 10 min; Duration: 3 to 6 hr.
  — Adverse effects: hypotension, bradycardia, dizziness, scalp tingling.
- Avoid in patients with heart block, bradycardia, CHF, severe asthma or bronchospasm.
- First or second line for eclampsia; excellent in catecholamine surges.

### *Enalaprilat*

- Intravenous formulation of enalapril (ACE inhibitor).
- Dose is 1.25 to 5.0mg q6 hour IV (duration of action ~6 hours).
- Onset of action in 15 to 30 minutes; Duration 6 hours or more.
- Highly variable response; precipitous BP drop in high-renin states, rarely angioedema, hyperkalemia, or acute renal failure.
- May be most useful in acute cardiogenic pulmonary edema.
- Avoid in acute myocardial infarction.

### *Diltiazem*

- Initial dose 0.25 mg/kg over 2 min, followed by infusion of 0.35 mg/kg at an initial rate of 10 mg/hour
- Onset: 3 to 30 min
- Adverse effects: excessive hypotension, flushing; rarely amblyopia.

*Hydralazine*

- Indicated primarily for eclampsia.
- Dose is 10-50 mg IV or IM titrate to effect (onset <20 minutes, duration 3 to 8 hours):
  - — Onset: 10 to 20 min; Duration: 3 to 8 hours.
  - — Adverse effects: tachycardia, flushing, contraindicated in angina or aortic dissection.
- Can be given IM as well, 10 to 50 mg (onset 20 to 30 minutes).
- Tachycardia, flushing, headache, vomiting, increased angina may occur.

*Nicardipine*

- IV formulation available though not commonly used.
- Dose is 5 to 15 mg/hr IV, onset 5 to 10 minutes, duration 1 to 4 hours.
- Do not use in acute CHF or with coronary ischemia.
- May be most useful for hypertension in the setting of subarachnoid hemorrhage.

*Esmolol*

- Very short half-life (2-4 minutes) non-selective β-blockade.
- Dose is 250 to 500µg/kg/min for 1 minute, then 50 to 100 µg/kg for 4 minutes.
- Sequence may be repeated, and continuous drip may be maintained.
- Onset of action is 1 to 2 minutes; 10 to 20 minute duration.
- Mainly for acute aortic dissection, perioperatively, acute coronary ischemia.
- May be used with caution in acute MI with depressed LV to modulate heart rate.
- Very close monitoring is required, and fluid load is large with this agent.

*Phentolamine*

- Mainly for catecholamine surges (pure alpha-adrenergic blockade)
- Dose is 5 to 15 mg IV; onset 1 to 2 minutes; duration 3 to 10 minutes
- Tachycardia, flushing and headache may occur.

*Diazoxide*

300 mg IV bolus - ? obsolete

- Onset: 1 to 2 min.
- Duration: 4 to 12 hours.
- Adverse effects: Sodium retention, hyperglycemia, tachycardia, palpitations, chest pains, sedation and somnolence.

## Consultations

1. Consultations may be indicated for co morbid conditions especially renal and endocrinal diseases for their definitive treatment[15].
2. Since hypertension is usually a chronic problem, access to a primary care physician and long-term follow-up are essential for all patients.
3. White-coat hypertension is a transitional condition to hypertension outside medical settings, suggesting that white-coat hypertension may carry a poor cardiovascular prognosis[16].
4. In patients having elevated blood pressure, despite taking medications, with evidence of target-organ injury a careful assessment of adherence to therapy is warranted. Since volume overload is common in refractory hypertension use of a diuretic is recommended. If interventions are ineffective, a different class of drug could be added, and the patient could be screened for renovascular hypertension. Regular follow-up is warranted, with a goal of maintaining the blood pressure below 140/90 mmHg[17].
5. Goal-oriented management in chronic hypertension revealed better control rates than what is reported. DBP control was easy to achieve, achieving SBP goal still remained difficult. Employing goal-oriented management can translate BP control results achieved in clinical trials into outpatient practice[18].

## Dangers of Rapid Reduction in Blood Pressure

Rapid reduction of BP in asymptomatic severe hypertension or hypertensive urgency is best avoided. Oral or sublingual drugs with rapid onset of action can result in an uncontrolled drop in blood pressure leading to stroke, myocardial ischemia and even death. Several serious side effects have been reported with the administration of sublingual fast-acting nifedipine[10]. Therefore, its routine use to lower blood pressure rapidly in the general adult population is to be discouraged.

## Hypertensive Emergencies in Children

Like adults emergency management of Hypertension requires clinical assessment before starting therapy. Multidisciplinary care is required to search for the

specific cause as the prevalence of hypertension is about 1%[19]. It is important to establish cause in children as secondary causes are more common. IV labetolol and nitroprusside are commonly used. Recently, IV Nicardipine has been used. Oral nifedepine has been used, but its use is controversial as its effect is less predictable[20].

## CONCLUSION

The dividing line between high normal and abnormally high BP threatening a life is to some extent artificial. Some patients may require treatment at even lower pressure with symptoms of target organ damage. However decision to treat hypertensive emergency should be based on individual symptoms rather than defined BP levels. The ever-changing scenario of cardiovascular, renal and neurological complications of hypertensive disease advocates early therapy in all age groups. The judicious lowering of blood pressure is required under clinical assessment with parentral drugs. Hypertensive emergencies have become less frequent in recent years but they still require very aggressive and careful management.

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