
Review Article

Diagnosis and treatment of hypertensive crises in the elderly patients

Joseph Varon,¹ Neil E. Strickman²

¹ University of Texas Health Science Center at Houston, Houston, Texas, USA

² Peripheral Vascular Lab at HGCA, Peripheral Vascular Interventional Cardiology at Texas Heart Institute / St Lukes Episcopal Hospital, Houston, Texas, USA

Abstract Hypertension is a common clinical problem in the elderly worldwide and physicians of all types are likely to encounter patients with hypertensive urgencies and emergencies in these patients. Although various terms have been applied to these conditions, they are all characterized by acute elevations in blood pressure and evidence of end-organ injury. Prompt, but carefully considered therapy is necessary to limit morbidity and mortality. A wide range of pharmacologic alternatives are available to the practitioner to control blood pressure and treat complications in these patients. The management of the elderly patient with hypertensive crises needs to include close monitoring and a gentle decline in blood pressure to avoid catastrophic complications, exacerbation of ischemic myopathy, and vascular insufficiency. (*J Geriatr Cardiol* 2007;4:50-5.)

Key Words hypertension; hypertensive crises; hypertensive encephalopathy; aortic dissection; beta-blocker; calcium channel blocker; clevidipine; fenoldopam; nitroprusside; labetalol; nicardipine; elderly

Introduction

Rapid control of blood pressure (BP) in elderly patients is sometimes needed in the emergency department (ED), operating room (OR) and intensive care units (ICU). Hypertensive crises in this group of patients are potentially life-threatening situations that are the result of elevated BP.¹⁻³ They may be associated with stroke, particularly intracerebral hemorrhage, but also with cerebral infarction.⁴ If these crises are not treated, the incidence of morbidity, including coronary events, congestive heart failure, and renal failure, as well as mortality increases.

Hypertension in the elderly is quite prevalent in the United States and in many countries around the World. A number of different clinical settings in persons older than 70 years accompany hypertensive crises and acute elevations of BP are not uncommon in this group.⁵ These clinical factors influence the therapeutic approach of the practitioner. Thus, healthcare providers of all specialties will undoubtedly be exposed to elderly patients with hypertension and similarly hypertensive crises will be seen by many types of healthcare professionals. Practitioners of anesthesiology, emergency medicine, internal medicine, surgery, and critical care medicine must therefore master

the management of hypertensive crises.

Definition

Unfortunately, a number of different terms have been applied to acute elevations of BP associated with end-organ dysfunction. Calhoun and Oparil described hypertensive crises simply as elevations of BP.¹ Other authors have defined hypertensive crises as a sudden increase in systolic and diastolic BP that causes end-organ damage including the central nervous system, the heart, or the kidneys.^{6,7}

Another term, hypertensive urgencies, has been used by some authors to refer to clinical situations in which blood pressure control should be achieved within a few hours.³ These same authors reserve the term hypertensive emergencies for those elevation of blood pressure requiring specific reductions within one hour in order to avoid serious morbidity or death. Another frequently encountered term, "malignant hypertension" is defined as a syndrome characterized by elevated blood pressure accompanied by encephalopathy or nephropathy.^{3, 8}

The classification and approach to hypertension undergoes periodic review by the Joint National Committee (JNC) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure with the most recent report (JNC 7) having been released in 2003.⁹ Although not specifically addressed in the JNC 7 report, patients with a systolic blood pressure of greater than 179 mmHg or a diastolic that is greater than 109 mmHg are usually defined as having a

Corresponding author: Dr. Neil E. Strickman, Clinical Professor of Medicine at Baylor College of Medicine, Director of Peripheral Vascular Lab at HGCA, Co Director of Peripheral Vascular Interventional Cardiology at Texas Heart Institute / St Lukes Episcopal Hospital, Houston, Texas, 77030, USA.
E-mail: hedeppe@hgcardio.com

“hypertensive crisis”. The 1993 report of the JNC proposed an operational classification of hypertensive crisis as either “hypertensive emergencies” or “hypertensive urgencies”.

Postoperative hypertension has arbitrarily been defined as systolic BP ≥ 190 mm Hg and/or diastolic BP 100 mmHg on two consecutive readings following surgery.^{9,10}

Epidemiology, etiology and pathogenesis

Hypertension is very prevalent in the American population. Over sixty million United States inhabitants suffer from hypertension.⁸ The vast majority of these patients have essential hypertension. Less than 1% of these patients will develop one or multiple episodes of hypertensive crises. The incidence of hypertensive crises is higher among blacks and the elderly. The majority of patients presenting with hypertensive crises have previously been diagnosed as hypertensive, and many have been prescribed antihypertensive therapy with inadequate BP control.^{11,12}

The incidence of postoperative hypertensive crises varies depending on the population examined. Postoperative hypertension in the elderly has been reported to occur in 4 - 35% of patients shortly after the surgical procedure.¹³⁻¹⁵ As noted above, hypertensive crises occur most commonly in elderly patients who have a previous history of hypertension and frequently accompanies discontinuation of medications.

The pathophysiology of hypertensive crises is thought to be due to abrupt increases in systemic vascular resistance likely related to humoral vasoconstrictors.¹⁶ With severe elevations of blood pressure endothelial injury occurs and fibrinoid necrosis of the arterioles ensues. This vascular injury leads to deposition of platelets and fibrin, and a breakdown of the normal autoregulatory function. The resulting ischemia prompts further release of vasoactive substances completing a vicious cycle.¹⁷

Clinical manifestation

The manifestations of hypertensive crises in the elderly are those of end-organ dysfunction (Table 1). Organ dysfunction is uncommon with diastolic blood pressures

Table 1. End-organ dysfunction in elderly patients with hypertensive emergencies

1. Hypertensive encephalopathy
2. Acute aortic dissection
3. Acute myocardial infarction
4. Acute cerebral vascular accident
5. Acute hypertensive renal injury
6. Acute congestive heart failure

less than 130 mmHg although it may occur.^{18,19}

It is important to recognize that the absolute level of BP may not be as important as the rate of increase.²⁰ For example, patients with long-standing hypertension may tolerate systolic BP of 200 mmHg or diastolic increases up to 150 mmHg without developing hypertensive encephalopathy, while non-elderly patients, children or pregnant women may develop encephalopathy with diastolic BP ≥ 100 mmHg.²¹

Headache, altered level of consciousness and less severe degrees of central nervous system dysfunction are the classic manifestations of hypertensive encephalopathy. In the elderly, these may be manifestations of other concomitant problems such as sepsis, dementia, etc. Acute cerebral vascular accidents with intraventricular bleeding or ischemic infarction may result in focal neurological abnormalities. Advanced retinopathy with arteriolar changes, hemorrhages and exudates as well as papilledema are commonly seen on examination of fundi in patients with hypertensive encephalopathy.

Cardiovascular manifestations of hypertensive crises may include angina or acute myocardial infarction. Cardiac decompensation may lead to symptoms of dyspnea, orthopnea, cough, fatigue or frank pulmonary edema. Severe injury to the kidney may lead to renal failure with oliguria and/or hematuria.

One syndrome warranting special consideration is aortic dissection. Propagation of the dissection is dependent not only on the elevation of the blood pressure itself, but also on the velocity of left ventricular ejection. For this reason, specific therapy aimed at both targets (blood pressure and rate of pressure rise) is utilized for these cases.²²

Initial evaluation of the patient with hypertensive crises

The key to successful management of a patient with hypertensive crises is the prompt recognition and initiation of treatment.^{23,24} This is accomplished by medical history and physical examination supported by appropriate laboratory evaluation. Certain critical questions should be resolved, if possible, such as what was the patient's blood pressure prior to presentation? Did the patient complain of any symptoms prior to the illness? And is there evidence of target organ (i.e., brain, heart, kidneys) involvement? In addition, prescribed and non-prescribed medications (or other drugs) the patient is taking should be ascertained.

Once these basic questions have been answered, the next issue is to determine whether or not the medical problem is a hypertensive emergency or urgency.^{1,3-5} In patients presenting *de novo* with hypertensive crises, the BP should be determined immediately by the physician in both arms. In addition, palpation of pulses in all extremities is necessary. A fundoscopic examination is mandatory in

these cases as well. This examination may be challenging among those elderly patients that have cataracts.

A complete blood count, electrolytes, blood urea nitrogen (BUN), creatinine and urinalysis should be obtained.²⁵ In addition, a chest x-ray, electrocardiogram and head computed tomography are useful in patients with evidence of shortness of breath, chest pain, or neurological changes respectively.²³ In many instances, these tests are performed simultaneously with the initiation of antihypertensive therapy.

Pharmacological management

A growing number of agents are available for management of hypertensive crises. The appropriate therapeutic approach will depend on the form of presentation and cause of hypertensive crises. A variety of routes of administration are currently used to treat patients with severe hypertension in whom it is felt necessary to lower BP over a short period of time. The following discussion is limited to hypertensive crises with a cardiovascular etiopathogenesis.

As previously mentioned, in patients with hypertensive crises, the systolic and diastolic BP should be promptly reduced. Many authorities recommend reductions of approximately 15% during the first hour, with gradual reductions to diastolic BP's of 100 to 110 mmHg or a reduction of 25% of the initial reading.²⁶ Reductions in BP in the elderly patient may result in ischemia and, thus, these patients must be carefully followed.²⁷⁻²⁹ Parenteral therapy with short acting agents is initially recommended. In our practice, most patients receiving parenteral therapy should have continuous BP monitoring.²⁶

Sodium nitroprusside

Sodium nitroprusside is a combined arterial and venous vasodilator that decreases both the afterload and preload. The mechanism of action of this drug is by reacting with cysteine to form nitrocysteine. The later activates guanylate cyclase which, in turn, stimulates the formation of cyclic GMP (cGMP) that relaxes the smooth muscle.³⁰ When using this agent, cerebral blood flow may decrease in a dose-dependent manner.²⁸ It is a very potent agent. The onset of action of this drug is within seconds, with a duration of action of one-to-two minutes and a plasma half-life of three to four minutes. Therefore, continuous BP measurement is recommended.²⁶ If the infusion is stopped, the BP begins to rise immediately and returns to the pre-treatment level within one to ten minutes.

Sodium nitroprusside is metabolized into cyanogen, which is converted into thiocyanate by the enzyme thiosulfate sulfurtransferase.³⁰ Therefore, cyanide poisoning may occur with prolonged intravenous administration of sodium nitroprusside. It is recommended to *consider* this side effect in elderly patients who develop central nervous system depression, seizures, lactic acidosis and/or cardiovascular

instability.²⁶ The toxicity of sodium nitroprusside occurs usually after several days of infusion; however, it may occur within the first 24 hours with high dose administration. In addition, cyanide poisoning may occur with infusion rates greater than 2 microgram/kg/min. For that reason, infusion rates of greater than 10 microgram/kg/min should not be continued for prolonged periods of time.²⁶

Calcium channel blockers

Nifedipine Oral therapy with nifedipine 10 mg q 5 min \times 2, has been suggested by some authors as an adequate form of therapy in patients with hypertensive crises.³¹⁻³⁵ Nifedipine is *not* absorbed through the buccal mucosa, and the common order for administration sublingually should be changed to bite and swallow.^{36, 37} Nifedipine causes direct vasodilatation of arterioles reducing peripheral vascular resistance promptly. Onset of action begins within 15 minutes of oral administration and peaks at 30 minutes. The duration of action may be 4 to 6 hours. This form of therapy however, is not without its drawbacks.³⁸ Sudden reductions in BP accompanying administration of nifedipine may precipitate ischemic events, particularly in the elderly.²⁷⁻²⁹ Nifedipine also produces reflex tachycardia, which in turn, in patients with pre-existing coronary artery disease may induce myocardial ischemia.

Nicardipine Nicardipine is a dihydropyridine derivative calcium channel blocker that may be used in elderly patients with acute hypertensive crises.³⁹ It differs from nifedipine by the addition of a tertiary amine structure in the ester side chain from position three of the dihydropyridine ring and the movement of the nitro group to the meta position of the phenyl ring. These differences make nicardipine one hundred times more water soluble than nifedipine and, therefore, it can be administered intravenously making nicardipine a titratable intravenous calcium channel blocker.⁴⁰

Several studies have examine the acute effects of nicardipine when administered to patients with severe hypertension.⁴¹⁻⁴⁵ There have also been several studies published comparing the effects of nicardipine with sodium nitroprusside. Halpern and coauthors, conducted a multicenter, prospective, randomized study comparing the effect of this agent in patients with severe post-operative hypertension.⁴⁴ They found nicardipine to be as effective as sodium nitroprusside.

Intravenous nicardipine offers some advantages in the emergency treatment of hypertensive crises. This drug has been shown to reduce both cardiac and cerebral ischemia in elderly patients.⁴⁶ Its dosage is independent of the patient's weight. The current recommended dosage for rapid BP control is 5 mg/h increasing the infusion rate by 2.5 mg/h every 5 minutes (to a maximum of 15 mg/h) until the desired BP reduction is achieved.

Clevidipine Clevidipine is a relatively new agent under investigation for management of post-operative hyperten-

sion and hypertensive emergencies.⁴⁷ It is also a dihydropyridine calcium channel blocker with a quick onset and offset of action. At this time clevidipine is available only for clinical trials.

Adrenergic-blocking agents

Labetalol Labetalol is a combined blocker of the alpha and beta adrenergic receptors. When given intravenously, labetalol produces a prompt and controlled reduction in BP in patients with hypertensive crises.⁴⁸ The effects of this drug begin five minutes after administration, and may last for at least four to six hours. The rapid fall in BP results from a decrease in peripheral vascular resistance and a slight fall in cardiac output. One of the advantages of this drug is that it is also effective as an oral antihypertensive agent and once the initial parenteral treatment has been established, it can be followed with oral administration. A reasonable administration protocol is to give an initial intravenous bolus of 0.25 mg/kg, followed by larger boluses (0.5 mg/kg) every 15 minutes until the BP is controlled or a total dose 3.25 mg/kg has been given.

Esmolol Esmolol is a beta-adrenergic blocking agent that has an extremely brief elimination half-life (< 10 minutes). This agent is available for intravenous use both as a bolus and as an infusion. It is of particular value for some dysrhythmias and recently has been used in some patients with hypertensive crises. The recommended initial dosage is 0.5-1 mg/kg followed by an infusion at 50-200 mcg/kg/min.

Phentolamine Phentolamine is an alpha-adrenergic blocking agent which is frequently used for management of catecholamine-induced hypertensive crises. This medication is given intravenously in 5-10 mg boluses.^{2, 26} The effect is immediate and may last up to 15 minutes. Continuous intravenous infusions have also been used with variable effects. This agent may cause tachydysrhythmias or angina in the elderly. Once the initial BP is under control, oral phenoxybenzamine, a long acting alpha adrenergic blocking agent, may be given.

Trimethaphan camsylate This drug is a non-depolarizing ganglionic blocking agent still in use in some countries despite its serious adverse effects. It blocks the transmission of impulses at the sympathetic and parasympathetic ganglia by competing with acetylcholine for cholinergic receptors. This accounts for both its efficacy and its numerous side effects. The reduction in BP observed with this agent is caused by the adrenergic blockade resulting in vasodilatation. The administration is by constant intravenous infusion (500 mg is mixed in 500 ml of distilled water), and is given as initial dose of 0.5 to 1 mg/min.^{2, 26} The dose is then titrated to achieve the desired BP. Tachyphylaxis is a common side effect with this medication. It usually occurs within the first two days of administration.

Diazoxide The mechanism of action of this drug is to relax the arteriolar smooth muscle and, thus reduce periph-

eral vascular resistance.²³ When given intravenously, the onset of action is within one minute with a peak action at 10 minutes, and a total duration of action ranging from 3 to 18 hours.⁴ The dose of administration of diazoxide is a minibolus of 1-3 mg/kg to 150 mg (single dose) injected over 10 to 15 seconds. If the response is inadequate, repeated doses at 10-15 minute intervals may be given.^{4, 26} Diazoxide also has significant side effects. Salt and water retention are commonly seen and hyperglycemia and hyperuricemia may also occur.

Clonidine Clonidine (0.1 mg PO q 20 min) has been used for the treatment of hypertensive crises, particularly in hypertensive urgencies.⁴⁹⁻⁵¹ This medication has been widely studied. In a random, double blind study, comparing the effects of oral nifedipine versus oral clonidine in 51 patients, clonidine was found to produce a more gradual decrease in BP than nifedipine.⁵² Sedation was observed in those elderly patients taking clonidine, and careful monitoring is required. In the authors' experience, this medication is an excellent choice for those patients in whom BP control within a few hours is desired.²⁶

Angiotensin-converting enzyme inhibitors

The use of angiotensin-converting enzyme inhibitors for the treatment of hypertensive crises has been studied over the last few years.⁵³⁻⁵⁶ Captopril is the prototype of these agents. In a study by Ceyhan and coworkers, the effects of sublingual captopril were compared to the effects of nifedipine in patients with hypertensive crises.⁵⁷ These authors found that sublingual captopril was very effective and that it was an excellent alternative to nifedipine in the urgent treatment of hypertensive crises. The anti-hypertensive effects of sublingual captopril occur at five minutes and persist for about 240 minutes. It is interesting to note that, whereas the heart rate increased in those patients who were treated with nifedipine, it decreased in those patients treated with captopril. No significant side-effects were seen in the captopril-treated group. Furthermore, the intravenous angiotensin-converting enzyme inhibitor Enalaprilat is now gaining popularity for use in some hypertensive emergencies.

Other agents

Nitroglycerin and hydralazine Nitroglycerin and hydralazine are sometimes used in the treatment of hypertensive crises and nitroglycerin may play a significant role in those patients with cardiac ischemic.^{2, 48, 58} Hydralazine and nitroglycerin are still widely used because compared to other agents these drugs are inexpensive. However, these agents have disadvantages, including unpredictable anti-hypertensive effects, difficult BP titrations, and serious potential adverse effects, such as profound hypotension, reduction of myocardial and cerebral blood flow, and increased myocardial workload.

Fenoldopam Fenoldopam is unique among the

parenteral blood pressure agents as it mediates peripheral vasodilation by acting on peripheral dopamine-1 receptors. Fenoldopam is rapidly and extensively metabolized by conjugation in the liver, without participation of cytochrome P-450 enzymes. The onset of action is within 5 minutes, with the maximal response being achieved by 15 minutes. The duration of action is between 30 to 60 minutes, with the pressure gradually returning to pretreatment values without rebound once the infusion is stopped.⁵⁹ No adverse effects have been reported. An initial starting dose of 0.1 micrograms/kg/min is recommended. Fenoldopam improves creatinine clearance, urine flow rates and sodium excretion in severely hypertensive patients with both normal and impaired renal function.

Other regimens utilizing medications such as reserpine, methyldopa or guanethidine have largely been replaced by the agents described above.

Conclusions

Hypertensive crises constitute a group of distinct clinico-pathological entities in which rapid control of BP is indicated to prevent serious complications. Several anti-hypertensive agents are available such as sodium nitroprusside, labetalol and nicardipine. Newer agents such as fenoldopam and clevidipine may have some advantages in the care of the elderly patient with acute hypertension.

The decision to rapidly lower BP in an elderly patient is no longer based on the BP alone; instead it is dependent on the benefit to be derived from treating hypertension and the risk of the drugs used in its treatment.

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