**Eur**opean **Rev**iew for **Med**ical and **Pharmacol**ogical **Sci**ences 2004; 8: 143-152

# Hypertensive crises: diagnosis and management in the emergency room

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*Abstract.* – **Hypertensive crises are commonly observed in an emergency room. Regardless blood pressure values, hypertensive crises are classified in emergencies, characterized by life-threatening acute organ damage, and urgencies, with no evidence of acute or progressive organ injury. In an hypertensive emergency an appropriate and immediate management with parenteral drugs is mandatory, while in an hypertensive urgency blood pressure should be decreased within 24-48 h with orally active agents.**

**This article reviews the spectrum of clinical syndromes that comprise hypertensive emergencies, focusing on specific drugs and therapeutic strategies available in the emergency department, based on current literature.**

**Since no randomized prospective trials are available, an evidence-based approach recommending an optimal therapeutical management is not possible. Much of the therapy is therefore entirely empirical and based on the underlying pathophysiologic and clinical findings.**

**Further studies are needed to clarify pathophysiologic mechanisms in order to optimize therapeutic approach.**

*Key Words:*

*Hypertension, Hypertensive emergency, Hypertensive urgency, Hypertensive crises, Hypertensive complication, Treatment.*

## Introduction

### Definition

Hypertensive crisis is defined as a critical elevation of blood pressure in which diastolic blood pressure (BP) generally exceeds 120 mmHg[1,2]. This threshold value is, however, not univocally established, since the severity of the clinical picture is not only determined by the absolute BP levels, but also by the magnitude and the rate of the pressure increase and by the underlying conditions[3,4]. For instance, blood pressure levels in eclampsia may be only slightly elevated; nevertheless, immediate treatment of hypertension in this setting is mandatory.

Hypertensive crises are traditionally subdivided in hypertensive emergencies and urgencies[5-7].

The presence of acute or progressive life threatening organ damage such as acute coronary syndrome, acute left ventricular failure with pulmonary oedema, eclampsia, aortic dissection, acute renal failure, hypertensive encephalopathy and haemorragic/ischaemic stroke constitutes an hypertensive emergency[5-7]. Many authors consider also accelerated-malignant hypertension an emergency, because sudden occurrence of complications such as stroke, acute renal failure or acute coronary syndrome in this setting is possible[8-10].

In most hypertensive emergencies, BP should be lowered within minutes using parental drugs[1,5,6].

An hypertensive urgency is an hypertensive crises without acute or progressive organ damage, and BP should be lowered in 24-48 hours to prevent development of acute organ damage[1,5,7]. According to the JNC VII, hypertensive urgencies include upper levels of stage II hypertension with symptoms like headache, dizziness, severe anxiety, epistaxis and shortness of breath. Some authors include in the definition also hypertensive crises in patients without evidence of acute or progressive organ damage but at high risk for developing new injury (patients with known target organ diseases such as chronic ischaemic heart disease or previous stroke)[11].

Casual detection of asymptomatic high BP levels without any sign of acute or progressive organ involvement may be defined as simple blood pressure rise[11]. Simple blood pressure rise may further be classified as transient hypertension (generally a cardiovascular response to pain or anxiety) or stable uncomplicated hypertension[12].

### Ethiology, Pathogenesis, Clinical Picture and Diagnosis

Any disorder that causes hypertension can give rise to a hypertensive emergency (Table I). The rate of change in blood pressure determines the likelihood that an acute hypertensive syndrome will develop[4]. Pre-existing hypertension may lower the probability of an hypertensive emergency through adaptive vascular changes that protect end organs from acute changes in BP[13].

The pathophysiology of the hypertensive crises is complex and incompletely understood: an initial abrupt rise in vascular resistance seems to be a necessary first step. This increased vasoreactivity may be precipitated by the release of vasodynamic substances such as norepinephrine and angiotensin II and can occur as a result of relative hypovolemia[13,14]. The compensatory endothelial vasodilatory responses are overwhelmed, leading to endothelial decompensation, which promotes further rises in BP[13]. Thus, a vicious circle, with progressive increases on vascular resistance and further endothelial dysfunction is initiated. Proinflammatory and adhesion molecules are released from the impaired endothelial cell layer, promoting local permeability, inflammation and vasoconstriction[15].

The clinical picture of an hypertensive crises may range from an asymptomatic presentation to specific symptoms characterizing an acute organ damage (dyspnea, chest pain, neurological disorders). In the absence of organ manifestations the patient may complain about non-specific symptoms such as palpitations, headache, dizziness.

By documenting the medical history, the medical status and by simple diagnostic procedures (ECG, fundoscopy, laboratory exams, and when indicated, chest ray, cerebral or chest CT scan) the differential diagnosis between emergency and urgency can generally be established at the emergency site within a very short period of time. This approach may also give some clues to define the cause of the hypertensive crises (e.g., cocaine abuse, pheochromocytoma, poorly controlled or previously unknown stage II hypertension), guiding to a more appropriate therapy. When an hypertensive emergency is suspected, treatment should be started as soon as possible, even before the results of these exams are available.

***Table I.*** Causes of hypertensive emergencies.

- Essential hypertension: poorly controlled blood pressure, antihypertensive drugs withdrawal
- Renal parenchymal diseases: acute glomerulonephritis, vasculitis, haemolytic uraemic syndrome, thrombotic thrombocytopenic purpura
- Renovascular diseases
- Endocrine diseases: pheocromocytoma, Cushing's syndrome, renin secreting tumors, mineralcorticoid hypertension (rare)
- Drugs: cocaine, sympathomimetics, erythropoietin, cyclosporine, interactions with monoamine-oxidase inhibitors (tyramine), amphetamines
- Autonomic hyperactivity: Guillame-Barrè syndrome, acute intermittent porphyria
- Central nervous system disorders: head injury, cerebral infarction/haemorrhage, brain tumors
- Eclampsia

## Management of Hypertensive Emergencies

Several parenteral agents are available for the treatment of hypertensive emergencies (Table II). Intravenous agents are generally preferred in this setting, since the effect of the treatment is rapid and occurs within a calculable period of time[13]. Moreover, intravenous treatment can be better regulated than medication administered orally or by the sublingual route .

Before administering the treatment, the risk of worsening of the end-organ damage must be weighed against the risk of rapid blood pressure lowering. Gradually decrease of mean BP level while minimizing the risk of hypoperfusion is the most important therapeutic principle in this setting[16]. For instance, patients with chronic hypertension have an altered cerebral autoregulation curve[17], and acute normotension would lead to cerebral hypoperfusion.

**Table II.** Parenteral drugs for treatment of hypertensive emergencies: pharmacological properties.

| Drug | Dose | Onset of action | Duration of action | Mechanism of action |
|---|---|---|---|---|
| *Labetalol* | 20-80 mg iv boluses or 0.5-2 mg/min by infusion | 10 min | 3-6 h | α/β-adrenergic blocker |
| *Esmolol* | 250-500 mg/kg/min iv bolus, then 50-100 µg /kg/min by infusion | 1-2 min | 10-30 min | β-adrenergic blocker |
| *Phentolamine* | 5-15 mg iv boluses | 1-2 min | 10-30 min | α-adrenergic antagonist |
| *Urapidil* | 25 mg iv boluses or 5-40 mg/h by infusion | 3-5 min | 4-6 h | α-adrenergic antagonist |
| *Fenoldopam* | 0.1-0.3 mg/kg/min by infusion | 5 min | 30 min | Dopamine 1 receptor agonist |
| *Nicardipine* | 5-15 mg/h by infusion | 5-10 min | 15-30 min | Calcium-channel blocker |
| *Enalaprilat* | 1.25-5 mg boluses every 6h | 15-30 min | 6-12 h | ACE inhibitor |
| *Sodium Nitroprussiate* | 0.25-10 mg/kg/min by infusion | Immediate | 1-2 min | Nitric oxid compound direct venous and arterial vasodilator |
| *Nitroglicerine* | 5-100 mg/min by infusion | 2-5 min | 5–10 min | Nitric oxid compound direct venous and arterial vasodilator (mainly venous) |
| *Hydralazine* | 10-20 mg iv boluses | 10–20 min | 1-4 h | Direct vasodilator |

To avoid cerebral, coronary and renal ischemia, mean BP levels should be reduced approximately by 25% within few minutes, reaching the goal of 160/100 mmHg within 2-6 hours[5,18]. BP should then be normalized in the following 24-48 h. Patients with aortic dissection[5] or pulmonary oedema[19] are excepted from the rule of gradual BP reduction: in these cases BP must be reduced as soon as possible to normal values or even lower. On the other hand, reduction of BP in stroke has been matter of debate for years, since a decrease of BP values in this setting may worsen the cerebral ischemic damage[13].

The choice of the drug greatly depends on the existing organ failure as well as on the reliable effectiveness and on the contraindications of the drugs (Table 3). Other selection criteria are duration of pressure elevation and underlying conditions (e.g., prior cardiovascular, cerebrovascular or renal disorders).

Diuretics should generally be avoided unless there is evidence of left ventricular failure and pulmonary oedema, because many patients have or develop hypovolemia during such emergencies, possibly as a result of pressure induced natriuresis[1,20].

Patients with an hypertensive emergency should be admitted to an Intensive Care Unit for continuous BP monitoring and parenteral drug administration[5].

**Table III.** Parenteral drugs for the treatment of hypertensive emergencies: indications, contraindications and side-effects.

| Drug | Adverse effects | Special Indications | Contraindications |
|---|---|---|---|
| *Labetalol* | Vomiting, bronchocostriction dizziness, heart block | Most hypertensive emergencies: in particular acute coronary syndrome aortic dissection,eclampsia | Heart failure asthma II degree heart block |
| *Esmolol* | Nausea bronchocostriction heart block | Acute coronary syndrome aortic dissection | Heart failure asthma bradycardia II degree heart block |
| *Phentolamine* | Tachycardia, flushing headache | Catecholamine excess | Acute coronary syndrome aortic dissection |
| *Urapidil* | Hypotension headache dizziness | Most hypertensive emergencies | |
| *Fenoldopam* | Headache, dizziness flushing, tachycardia hypokalemia | Renal failure | Glaucoma |
| *Nicardipine* | Tachycardia, headache, flushing | Renal failure stroke h. encephalopathy | Heart failure acute coronary syndrome aortic dissection |
| *Enalaprilat* | Variable response with possible BP precipitous fall | Left ventricular failure | Acute coronary syndrome |
| *Nitroprussiate* | Vomiting, sweating, thiocynate and cyanide intoxication | Most hypertensive emergencies | Caution with high intracranial pressure |
| *Nitroglycerine* | Headache, vomiting, tolerance | Acute coronary syndrome left ventricular failure | |
| *Hydralazine* | Tachycardia, flushing headache, vomiting | Eclampsia | Acute coronary sindrome, aortic dissection |

### Stroke

Management of the hypertensive crises during ischaemic stroke is a therapeutic dilemma, because a rapid fall of BP levels may compromise cerebral blood flow, leading to hypoperfusion of the peri-infarction area with consequent worsening of the ischaemic damage[21,22]. Furthermore, in many patients with acute stroke, hypertension resolves spontaneously within 48 h[23]. On the other hand severe hypertension may lead to direct vascular damage, extension of the perifocal oedema and hemorrhagic transformation of the infarction[24].

Optimal management of hypertensive crises during ischaemic stroke has not been established. The general agreement is that antihypertensive treatment should be withheld unless the diastolic BP is > 120 mmHg or the systolic BP is > 220 mmHg[24,25]. Aim of the therapy should be a cautious reduction of BP by about 10% to 15%[25]. If the patient is eligible for thrombolytic therapy, careful management of BP is critical, because excessive high pressure levels are associated with high risk of parenchymal haemorrhage after thrombolysis[26]. In these cases BP values should be kept < 185/110 mmHg at the time of the treatment and in the following 24 h[24].

Haemorrhagic stroke requires more aggressive blood pressure control: the American Heart Association guidelines recommend to keep mean arterial pressure < 130 mmHg[27].

Management of hypertension in subarachnoid haemorrhage should be targeted toward averting re-haemorrhage on one hand, and reduced cerebral perfusion, due to arteriolar vasospasm, with secondary brain ischemia, on the other hand. There are no data or consensus about optimal BP values in this setting. Some authors advise to maintain mean and systolic arterial pressure 15% above baseline[28], while other authors[29] suggest a more aggressive treatment maintaining the peak systolic pressure 20 % below baseline.

Centrally acting drugs such as clonidine should be avoided because of their capacity to interfere with mental status[1]. Parental agents, such as labetalol, easily titrated and with minimal dilatory effect on cerebral vessel are the first choice therapy[24]. Other possible agents are Esmolol, Enalaprilat[30], Urapidil[31] or Nicardipine[16]. In some cases combination of these drugs may be necessary for adequate arterial pressure control. Some authors suggest addition of nitroprussiate if hypertension is resistant to β-blockers or ACE inhibitors[24]. This drug should be administered very cautiously, if at all, since its vasodilatory properties may lead to increase intracranial pressure exacerbating cerebral ischemia[28].

Nimodipine is currently administered in subarachnoid haemorrhage to prevent cerebral arteriolar vasospasm[29]. Since nimodipine may lower BP, antihypertensive agents should be given only if nimodipine has been ineffective on systemic arterial pressure.

### Hypertensive Encephalopathy

Hypertensive encephalopathy is defined as an acute organic brain syndrome occurring as a result of failure of the upper limit of cerebral vascular autoregulation[13]. Cerebral blood flow is autoregulated within specific limits: as mean arterial pressure increases, compensatory cerebral vasoconstriction limits cerebral hyperperfusion. In a normotensive individual cerebral blood flow remains unchanged between mean arterial pressures of 70 and 150 mmHg; in hypertensive individuals these limits are shifted to higher levels (110 and 180 mmHg)[10,32,33]. When mean arterial pressure exceeds the upper limit of autoregulation, cerebral vasodilation ensues with overperfusion and cerebral oedema[11,14].

The pathogenesis of hypertensive encephalopathy seems to be related to cerebrovascular endothelial dysfunction with disruption of the blood-brain barrier resulting in cerebral oedema and microhaemorrhage formation[13].

Symptoms are acute or subacute onset of lethargy, confusion, headache, visual disturbance and seizures. If not adequately treated hypertensive encephalopathy can progress to massive cerebral haemorrhage, coma and death[13].

Suitable drugs in the management of hypertensive encephalopathy include labetalol, enalaprilat, nicardipine, urapidil, hydralazine[13,16]. Although sodium nitroprussiate may increase intracranial pressure, many experts continue to advocate it's use[13,21]. Clonidine should be avoided because it is a central nervous system depressant[1,13]. In elderly patients and in those with pre-existing hypertension, altered cerebral autoregulation limits demand cautious treatment: overzealous BP pressure lowering may determine cerebral hypoperfusion, with worsening of the neurological status and stroke[13].

### Acute Coronary Syndrome

Acute coronary syndromes include acute myocardial infarction with ST segment elevation, acute myocardial infarction without ST segment elevation and unstable angina. β-blockers, nitrates, oxygen and aspirin are traditionally emergency department first line therapy in acute coronary syndrome[34-37]. In particular, the positive effects on survival and on reduction of the infarction area of beta blockade during acute myocardial infarction are well known[38,39]. Since β-blockers and nitrates effectively lower BP, they are the first choice therapy in hypertensive crises during acute coronary syndrome. Nitrates, and in particular nitroglycerine, decrease the cardiac preload, the left ventricular filling pressure and, to a lesser extent, also the cardiac afterload inducing arterial dilation: the result is a decrease of myocardial oxygen consumption and a reduction of arterial pressure levels[13,21,37]. These drugs also dilate the coronary arteries, facilitating coronary blood flow.

It is well known that β-blockers have negative chronotropic and inotropic effects, decreasing cardiac output and dramatically reducing myocardial oxygen demand. The

longer diastolic filling time promotes coronary blood flow, increasing myocardial perfusion[40]. Nevertheless, the magnitude of the BP decrease in the first 24 hours after β-blocker administration is not predictable, since the reduction of the cardiac output determines a transient reflex rise of the peripheral vascular resistance. In cases of hypertensive crises during acute coronary syndrome a more definite antihypertensive effect is suitable, and labetalol is a reasonable choice. Owing to its competitive β- and α-inhibition properties, labetalol reduces vascular resistance and arterial BP without induction of reflex tachycardia[1,21].

Dihydropyridines, such as nicardipine, and hydralazine should be avoided, since these drugs enhance sympathetic outflow increasing the cardiac work.

### Left Ventricular Failure and Pulmonary Oedema

The pathogenesis of acute left ventricular failure is related to a critical interaction between progressive decrease in cardiac systolic performance and an acute increase in systemic vascular resistance. This leads to a decrease in cardiac index and increase in left ventricular diastolic filling pressure with a steep increase in pulmonary venous, and hence pulmonary capillary pressure inducing exudation of fluid from the intravascular compartment into the lung interstitium and alveoli. The consequent decrease of $O_2$ saturation leads to myocardial ischemia, further impairing the cardiac performance[19]. High BP levels in this setting worsen the left ventricular afterload mismatch decreasing further the cardiac output.

Immediate goals of the treatment is improving systemic oxygen saturation and inducing a rapid vasodilation of both arteries and veins, thus decreasing vascular resistance, alleviating afterload mismatch and reducing preload of both left and right ventricles[19].

Sodium nitroprussiate achieves both venodilation and arterial vasodilation, decreasing pre- and afterload[16,21]. Nytroglicerine is a reasonable alternative that has less afterload reducing capability, but it may increase myocardial blood flow to ischemic areas[16,21]. Intravenous furosemide has immediate venodilatory properties, leading to venous blood pooling and decreased ventricular preload. The subsequent diuretic effect further decreases ventricular preload and reduces BP levels, thereby positively affecting also the afterload mismatch[41]. ACE-inhibitors may be useful in this setting[14,16].

Drugs decreasing myocardial contractility, such as labetalol, should be avoided.

Concomitant therapy with opioids and oxygen supply may enhance the efficacy of antihypertensive agents[16].

### Acute Aortic Dissection

Regardless the type of aortic dissection and the further management (surgical therapy, endovascular stent placement, pharmacological treatment), aim of the first line therapy is to prevent propagation of the dissection. Advancement of the dissection critically depends on the hydrodynamic forces in the bloodstream: these are mainly related to the mean BP levels and to the steepness of the pulsewave (dP/dt)[42]. Aim of the treatment is to reduce the force of the left ventricular contractions, in order to decrease the steepness of the aortic pulsewave on one hand, and to reduce cardiac output with a fall of mean BP levels on the other hand. Thus β-blockers, owing to their negative inotropic properties, are standard therapy for aortic dissection. Moreover, the negative chronotropic effect of β-blockers decrease the number of left ventricular contractions per minute, with a further reduction of the total pulsatile load on the aortic wall[11,42].

In cases of hypertensive crises associated to aortic dissection, a β-blocker (propanolol, esmolol) should be started in addition to nitroprussiate[43]. The latter agent should never be administered without previous beta blockade, since the reflex catecholamine release secondary to the nitroprussiate induced vasodilation may result in an increase in left ventricular contraction force[42]. Labetalol, a potent antihypertensive agent with β-blocker properties, is an alternative to the combination β-blocker and nitroprussiate[42,43]. If β-blockers are contraindicated, urapidil is a reasonable choice[21,31].

Treatment should be started as soon as the diagnosis of aortic dissection is suspected, and the systemic arterial pressure should reach the lowest levels allowing organ perfusion (systolic BP between 100 and 110 mmHg)[5,42].

### Eclampsia

Preeclampsia is characterized by hypertension diagnosed after 20 weeks gestation (BP values > 140/90 mmHg) and proteinuria[45]. Other features consistent with severe preeclampsia are neurological symptoms such as headache, visual disturbances, oliguria, thrombocytopenia, increased liver enzymes and pulmonary oedema. Eclampsia is the new onset of seizures before, during or after labor, not attributable to other causes, in a woman with preeclamsia[45]. Seizures generally occur as a result of hypertensive encephalopathy. The best treatment of preeclampsia or eclampsia is delivery[44]. If delivery is not possible or warranted then management should include hospitalization, close observation, antihypertensive treatment and prophylaxis against convulsions. Prevention and treatment of eclamptic seizures is best achieved by administration of magnesium sulphate[46]. Treatment with specific antihypertensive agents should be initiated when diastolic pressure exceeds 105 mmHg, or when it increases rapidly from a near normal range to > 100 mmHg[14]. Hydralazine, administered in repeated intravenous boluses is the most commonly used drug in eclampsia[14,44]. Labetalol is also effective in this setting, either as an intravenous bolus or by continuous infusion[13,14].

### Acute or Progressive Renal Failure

Acute renal failure may be a cause or a consequence of hypertensive emergency[11,13]. Hypertensive emergencies are common in patients with renal transplant, especially those receiving cyclosporine and corticosteroids[13]. Severe hypertension in young patients should raise the possibility of intrinsic acute renal disease, such as acute glomerulonephritis. Intrarenal vasculitis, sometimes occurring in scleroderma, is a rare cause of acute renal failure and consequent blood pressure increase[11]. On the other hand, accelerated-malignant hypertension causes frequently acute renal failure[11].

The primary goal in the management of new-onset renal insufficiency accompanying severe hypertension is to limit further renal damage through BP control. Antihypertensive drugs that preserve renal blood flow, such a calcium antagonists and alfa-adrenergic blocking agents are appropriate[13,16]. Labetalol, owing to its alfa-inhibiting properties is an excellent choice[13,16]. Diuretic use in renal failure and severe hypertension may be beneficial or deleterious, depending on the patient's volume status[13].

If hypertension remains severe or refractory, other vasodilators, such as sodium nitroprussiate or fenoldopam[13,16] can be used.

### Accelerated-Malignant Hypertension

Accelerated-malignant hypertension is a rare form of hypertension characterized by fibrinoid necrosis of arterioles in many vascular beds[47]. Accelerated-malignant hypertension may complicate any form of chronic hypertension, but it occurs most commonly in young black men with underlying renal or renovascular diseases[11]. The diagnosis is made by the presence of severe hypertension in association with bilateral retinal haemorrhages, cotton wool spots or exudates with or without papilledema[48]. Other features of accelerated-malignant hypertension are hemolysis and thrombocytopenia due to red cell and platelet fragmentation[8]. The main complications of malignant hypertension are stroke, myocardial infarction, hypertensive encephalopathy and renal failure. Direct pressure effects, volume depletion, activation of the renin-angiotensin system, imbalanced production of nitric oxid and natriuretic petides and oxidative stress have all been implicated in the pathogenesis of accelerated-malignant hypertension[49].

Most of the complications are related to intravascular thrombosis due to endothelial damage. These abnormalities probably improve with good BP control[47].

Treatment of accelerated-malignant hypertension should start immediately, and any of the parenteral antihypertensive agents is appropriate in this setting[11]: drug selection criteria are ongoing complications (stroke, acute renal failure, myocardial ischemia) and preexisting conditions (previous chronic renal insufficiency, heart failure).

## Management of Hypertensive Urgencies

In a hypertensive urgency the patient's BP should be reduced within a period of 24 to 48 hours. Such adjustment can be achieved on

an out-patient basis, however, only if the patient can be followed up adequately for early detection of a renewed crises[5,16,21]. Generally oral medications are used for gradual reduction of blood pressure[5,16]. Selection of the antihypertensive agent depends on the patient's medical history and on any underlying chronic disease.

Stable uncomplicated hypertension should be treated with new oral antihypertensive agents or reinstitution of previous medication if non compliance is a problem.

Transient hypertension due to pain or anxiety is best treated with analgesic or anxiolytic medications[16].

## Management of Catecholamine Induced Hypertensive Crises

Catecholamine-induced hypertensive crises are characterized by a sudden increase in predominantly α-adrenergic tone[21]. Catecholamine-induced crises may present as an hypertensive urgency, or may cause acute end organ damages. The most common causes are ingestion of sympathomimetics, clonidine withdrawal, interaction of monoamine oxidase inhibitors with tyramine rich foods (certain beers, wine, chicken liver) and pheochromocytoma.

Generally, first choice drugs are alfa-adrenoceptor blockers such as phentolamine[21].

Pheochromocytoma is a rare chromaffin cell tumor producing catecholamines[50]. Typically patients show sustained or paroxysmal hypertension with headache, palpitations and sweating. During such crises patients may develop end organ damages such as myocardial infarction, hypertensive encephalopathy, stroke and congestive heart failure[50]. In this setting, immediate treatment is crucial, and phentolamine in repeated boluses or in continuous infusion is the best choice. Commonly used alternatives are nitroprussiate with β-blockers[21] or nicardipine[50]. β-blockers as exclusive agents are contraindicated, since unopposed alfa-mediated peripheral vasoconstrinction may lead to further BP rise[16,21]. If tachycardia, arrhythmia or angina are present, beta adrenoceptor blockers are indicated after an appropriate alfa adrenoceptor blockade. Possible alternative is labetalol, owing to its alfa-beta adrenoceptor blocking properties[16,21]. Treatment of urgencies, with less severe hypertension, should include alfa-adrenoceptor blocking agents that can be given orally, such as doxazosine.

Cocaine use can result in a typical sympathomimetic syndrome with tachycardia, arrhythmias, hypertension, hyperthermia and agitation[51]. Complications include myocardial ischemia, cerebral infarction, intraparenchymal or subarachnoid haemorrhage and rarely aortic dissection. Severe hypertension is best treated with phentoalamine, labetalol or nitroprussiate plus β-blockers[16,21]. As in pheochromocytoma, β-blockers alone should be avoided because of paradoxical BP rise, due to unopposed peripheral alfa-adrenergic mediated vasoconstriction. Chest pain usually responds to nytroglicerine. If myocardial infarction develops, the combination of nytroglycerine plus labetalol seems the best choice. Phentolamine is considered second line agent for cocaine-induced hypertensive crises with chest pain[51].

## Conclusions

Severely elevated BP subtend different clinical entities with markedly different timelines varying in the immediacy with which they should be treated.

Patients with hypertensive crises are not good candidates for prospective randomized trials, and data attesting benefits of acutely lowering BP in this condition are not available. Since an evidence-based approach recommending an optimal therapeutical management is not possible, much of the therapy is entirely empirical and based on the attempt to best match pathophysiological findings with pharmacologic properties of antihypertensive agents.

Choice of the appropriate agent should therefore be based on clinical findings, mechanism of action and potential adverse effect.

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