Introduction

Among the various emergencies the physician encounters in his practice hypertensive crises form a sizeable proportion. It is estimated that approximately 1 billion individuals worldwide suffer from hypertension and 1% of these persons will develop acute elevation of blood pressure at some point in their lifetime. The literature is replete with confusing terminology regarding severely elevated Blood Pressure (BP). The simplest and most clinically useful terms are as follows:

A. Hypertensive Emergencies: Defined as elevation of Diastolic Blood Pressure (DBP) readings >130 mm Hg along with Systolic Blood Pressure (SBP)>200 mm Hg with evidence of target organ involvement.

B. Hypertensive Urgencies: Defined as elevation of SBP & DBP as in above group but without target organ involvement.

The therapeutic implication of above division is important in that BP has to be lowered rapidly (within 1 hour) in hypertensive emergencies (HE) while normalization of BP over the next 24 hours is adequate in hypertensive urgencies.

The incidence of hypertensive crises has declined to approximately 1% of patient’s previously diagnosed hypertension. This is in sharp contrast to a 7% incidence with papilloedema in patients of untreated hypertension before the availability of modern antihypertensive drugs.

Pathophysiology

The pathophysiology underlying the development of hypertensive crises remains unclear. It is hypothesized that mechanical stress in the arteriolar wall, caused by the abrupt elevation of BP, leads to disruption of endothelial integrity and loss of vasoprotective effects of endothelium derived nitric oxide as well as release of vasoconstrictive agents such as angiotensin II and norepinephrine. The resulting endovascular damage leads to activation of coagulation cascade, platelet deposition, and intravascular hemolysis. Arteriolar fibrinoid necrosis, the hallmark of severely elevated BP, ensues and leads to loss of autoregulatory function with resultant target ischaemia. Release of vasoactive substances and myointimal proliferation set the stage for target organ infarction in a vicious cycle of events. Other hypotheses blame the role of abnormalities in certain cellular transport mechanisms, vasoconstrictive...
substances like endothelin-1 and functional antibodies against alpha adrenergic receptors and angiotensin II receptors to be the reasons for extreme BP elevation.

Clinical Syndromes
In everyday practice, hypertensive crises occur in a variety of clinical settings. The urgency of treatment is dictated by the clinical setting.

The commonly encountered HE are outlined in Table 1.

Clinical Evaluation
A detailed history, thorough physical examination and selected laboratory tests will help identify patients with hypertensive crises and determine whether specialized investigations and/or treatment modalities are indicated. Emergency room evaluation should look for signs of cardiovascular, neurological, renal or ocular damage such as cardiac failure, aortic dissection, altered sensorium, focal neurological deficits, renal insufficiency, retinopathy. Baseline laboratory tests should include complete blood count, serum electrolytes, blood urea nitrogen and creatinine, urinalysis, electrocardiogram and x-ray of chest. An ultrasonographic evaluation of renal morphology with Doppler assessment of renal blood flow in selected cases may yield important information. CT scan or MRI scan of brain always helps plan further course of action in patients with neurological deficit.

Initial Management
Hypertensive crises constitute some of the clinical situations where treatment has to take precedence over detailed investigative work up. The principles of management of HE revolve around the fact that normotension has to be restored so that target organ damage can be prevented or minimized. Animal and human studies indicate that organ perfusion, in particular cerebral perfusion, is auto regulated over a fairly wide pressure range. However, abrupt changes of more than 25% of the mean arterial pressure may exceed the brain’s ability to maintain blood flow reliably. Thus, the general approach to treating hypertensive emergency is to reduce the mean BP by about 25% over the course of minutes to several hours (depending on the clinical situation) with further reductions accomplished more gradually. Generally, the initial reduction should be achieved over 1 to 4 hours, with less rapid reduction occurring over the subsequent 24 hours to a DBP of about 100 mm Hg. Only in the case of aortic dissection or coronary ischaemia should BP be reduced to normotensive levels in the first day. A common error in the management is the discontinuation of parenteral therapy prior to establishment of effective BP control with oral antihypertensive drugs, thus leading to a rebound rise in BP.

The commonly used parenteral antihypertensive agents are shown in Table 2.
Antihypertensive drug choice

The choice of antihypertensive agent for treating hypertensive emergency depends on the clinical setting as well as the etiology of BP elevation. In most cases sodium nitroprusside is drug of choice since it is a potent drug with an instant onset as well as withdrawal of action, allowing rapid and controlled titration. Intra-arterial BP monitoring may be required to assess BP control. Since both cardiac preload as well as afterload are reduced simultaneously, myocardial oxygen demand is reduced, making an attractive agent in a setting of cardiac failure.

Intravenous nitroglycerine lowers afterload and myocardial oxygen demand while improving the coronary perfusion, thus making it the first choice in a setting of myocardial ischaemia or infarction. The draw back of nitroglycerin is that it produces less predictable response than nitroprusside while rapid development of tolerance and headache may pose problems for the physician.

Fenoldapam mesylate is a peripherally acting dopamine-1 agonist that can be used as a parenteral antihypertensive drug. It lowers BP by peripheral arterial dilatation while maintaining renal perfusion. Renal function remains protected by the unique renal tubule mediated natriuretic property of the drug. Intra arterial BP monitoring is not required during infusion of fenoldapam.

Labetalol, an alpha blocker and non cardio selective β-blocker can be administered safely in most of the hypertensive emergency settings and is of particular value in hyperadrenergic states. It reduces peripheral vascular resistance without any change in heart rate or cardiac output.

Diazoxide (a powerful arteriolar dilator) and Timetaphan (a potent ganglion blocker) are some of the other agents useful in HE.

Most of the patients presenting with hypertensive crisis are volume depleted, presumably due to pressure induced natriuresis, and further diuresis may complicate renal function. Accordingly diuretic therapy is not useful in the initial stages unless there is evidence of volume overload such as CHF or pulmonary...

### Table 2: Parenteral Drugs for Hypertensive Emergencies

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Onset of Action</th>
<th>Duration of Action</th>
<th>Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitroprusside</td>
<td>0.5-10µg/Kg/min. increase 5-10µg/Kg/min. every 5-10 min.</td>
<td>Immediate</td>
<td>1-2 min.</td>
<td>Nausea, vomiting Cyancide toxicity</td>
</tr>
<tr>
<td>Nitroglycerin</td>
<td>5-100µg/min. Increase every 3-5 min.</td>
<td>2-5 min.</td>
<td>3-5 min.</td>
<td>Hypotension, headache Nausea, vomiting</td>
</tr>
<tr>
<td>Labetalol</td>
<td>0.5-2mg/min. Infusion or 20-80 mg q5-10 min. (upto 300mg)</td>
<td>3-6 min.</td>
<td>3-6 hrs.</td>
<td>Heart block, ushing bronchospasm hypotension</td>
</tr>
<tr>
<td>Nicardipine</td>
<td>5-15mg/hr. increase by 1-2.5 mg/h q15 min.</td>
<td>5-10 min.</td>
<td>1-4 hrs.</td>
<td>Tachycardia, headache</td>
</tr>
<tr>
<td>Phentolamine</td>
<td>2-5 mg q5-10 min.</td>
<td>1-2 min.</td>
<td>3-10 min.</td>
<td>Hypotension, angina tachycardia, headache</td>
</tr>
<tr>
<td>Enalaprilat</td>
<td>1.25-5 mg q6h</td>
<td>15 min.</td>
<td>6 hrs.</td>
<td>Angioedema, rash hypotension</td>
</tr>
<tr>
<td>Esmolol</td>
<td>200-500 µg/kg loading dose 50 µg/kg for 4 min increase by 50 µg/min. q5min up to 200 µg/kg/min</td>
<td>1-2 min.</td>
<td>10 min.</td>
<td>AV block, heart failure bronchospasm, apnoea, hypotension</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>10-20 mg @ 1 mg/min.</td>
<td>10-20 min.</td>
<td>3-8 hrs.</td>
<td>Tachycardia, angina, ushing, headache</td>
</tr>
<tr>
<td>Diazoxide</td>
<td>50-150 bolus or</td>
<td>2-5 min.</td>
<td>3-12 hrs.</td>
<td>Hypotension, tachycardia</td>
</tr>
<tr>
<td>Trimetaphan</td>
<td>0.5-15mg/min.</td>
<td>1-5 min.</td>
<td>10 min.</td>
<td>Hypotension, bowel and bladder paresis</td>
</tr>
</tbody>
</table>
Hypertensive Emergencies

rales. However, diuretics (like frusomide or bumetanide) have a role in later stages of management of hypertensive crisis, when the effective control of BP with vasodilators activates baroreceptor mediated compensatory fluid and salt retention.

Emergency management of acute aortic dissection needs special mention, in view of the urgency of lowering of BP to prevent shear stress and prevent extension of dissection. In the absence of BP reduction, 25% of patients die within 24 hours and 60-70% die within 2 weeks. As soon as the diagnosis of aortic dissection is suspected, BP needs to be lowered to the lowest tolerated level (SBP 100-110 mm Hg) using a combination of Nitroprusside and β-blockers. It is vital to establish effective beta blockade with esmolol or inderal intravenously, before Nitroprusside is administered. Labetalol alone or in combination with nitroprusside is another alternative therapy in this setting.

Role of short acting nifedipine in HE is controversial since it’s the effect is variable and unpredictable. Moreover rapid reduction of BP over 20-30 min may be hazardous in a setting of cerebral or myocardial infarction.

Follow up of Patients
All patients on discharge from hospital after treatment of hypertensive crisis, must be followed up to assess effective BP control and to look for target organ damage and to look for undiscovered causes of secondary hypertension.

References