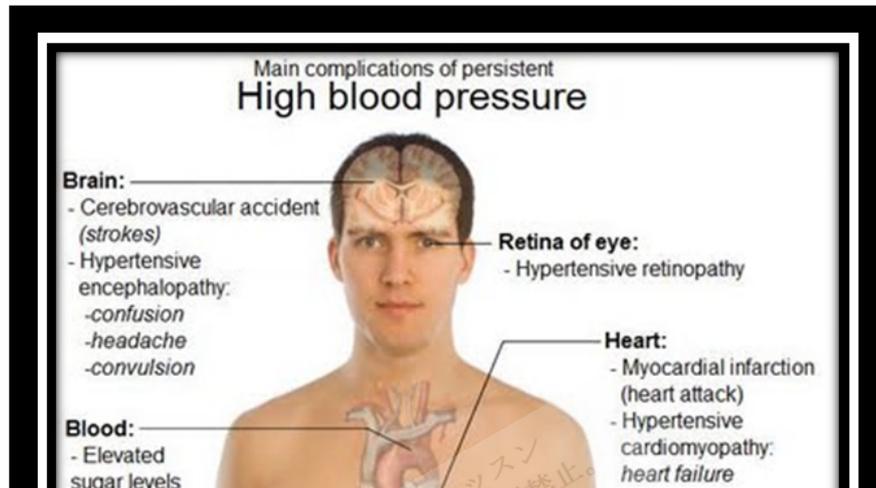


# Hypertensive Emergencies



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organs (primarily the brain, cardiovascular system, and kidneys). Diagnosis is by BP measurement, ECG, urinalysis, and serum BUN and creatinine measurements. Treatment is immediate BP reduction with IV drugs (eg, nitroprusside,  $\beta$ -blockers, hydralazine).

Target-organ damage includes **hypertensive encephalopathy**, **preeclampsia** and **eclampsia**, acute left ventricular failure with pulmonary edema, **myocardial ischemia**, **acute aortic dissection**, and **renal failure**. Damage is rapidly progressive and often fatal.

Hypertensive encephalopathy may involve a failure of cerebral **autoregulation** of blood flow. Normally, as BP increases, cerebral vessels **constrict** to maintain constant **cerebral perfusion**. Above a mean arterial pressure (MAP) of about 160 mm Hg (lower for **normotensive people** whose BP suddenly increases), the

cerebral vessels begin to **dilate** rather than remain constricted. As a result, the very high BP is transmitted directly to the capillary bed with **transudation** and **exudation** of **plasma** into the brain, causing cerebral edema, including **papilledema**.

Although many patients with stroke and **intracranial hemorrhage** present with elevated BP, elevated BP is often a consequence rather than a cause of the condition. Whether rapidly lowering BP is beneficial in these conditions is unclear; it may even be harmful.

**Hypertensive urgencies:** Very high blood pressure (eg, diastolic pressure > 120 to 130 mm Hg) without target-organ damage (except perhaps grades 1 to 3 retinopathy) may be considered a hypertensive urgency. BP at these levels often worries the physician; however, acute complications are unlikely, so immediate BP reduction is not required. However, patients should be started

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may cause **lethargy** or **nausea**.

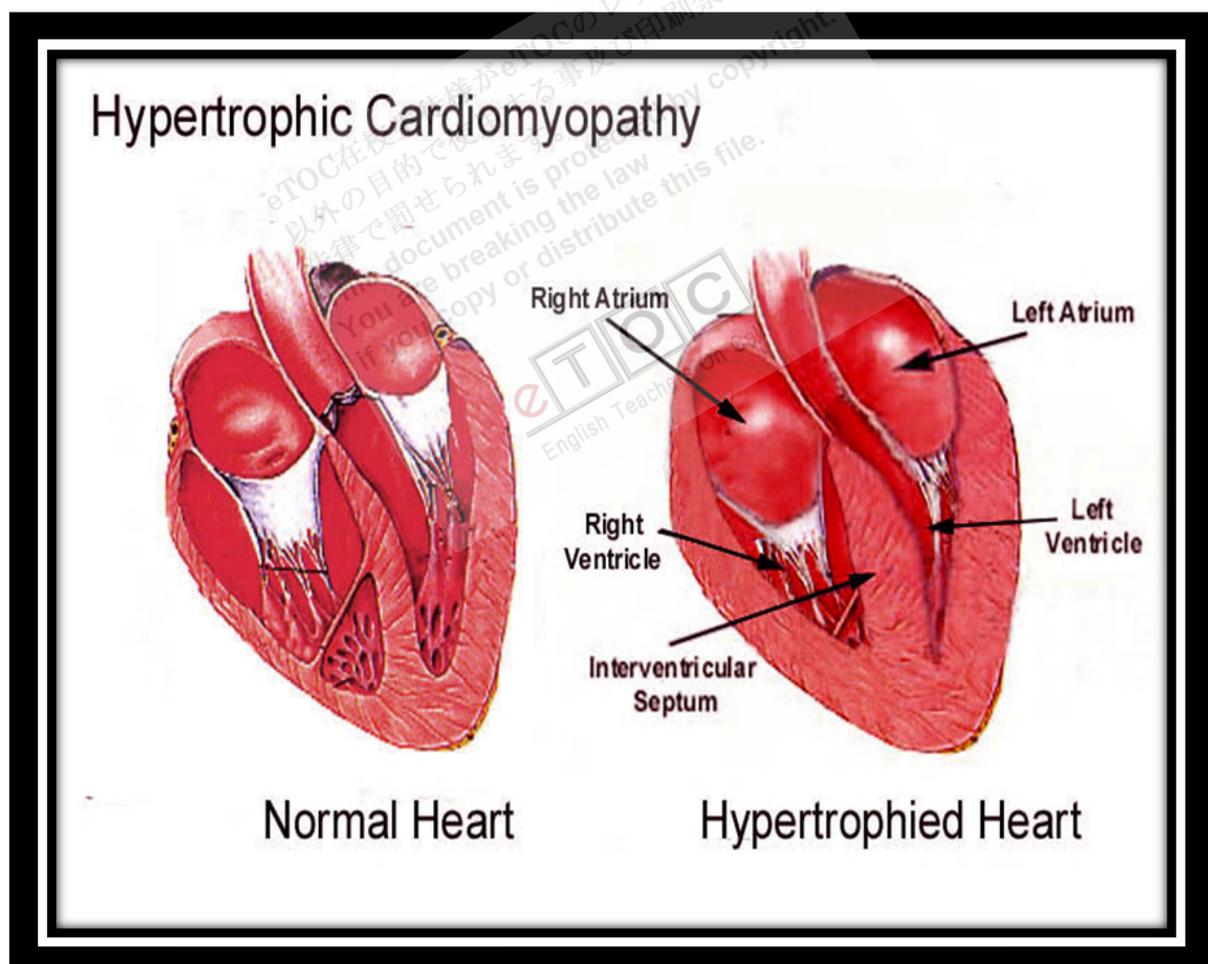
Physical examination focuses on target organs, with neurologic examination, **funduscopy**, and cardiovascular examination. Global cerebral deficits (eg, confusion, **obtundation**, coma), with or without focal deficits, suggest encephalopathy; normal mental status with focal deficits suggests stroke. Severe retinopathy (**sclerosis**, cotton-wool spots, arteriolar narrowing, hemorrhage, **papilledema**) is usually present with hypertensive encephalopathy, and some degree of retinopathy is present in many other hypertensive emergencies. Jugular venous distention, basilar lung crackles, and a 3rd heart sound suggest pulmonary edema. **Asymmetry** of pulses between arms suggests aortic dissection.

## Diagnosis

- Very high BP
- Identify target-organ involvement: ECG, urinalysis, BUN, creatinine; if neurologic findings, head CT

Testing typically includes ECG, urinalysis, and serum BUN and creatinine. Patients with neurologic findings require head CT to diagnose intracranial bleeding, edema, or **infarction**. Patients with chest pain or dyspnea require chest x-ray. ECG abnormalities suggesting target-organ damage include signs of left ventricular **hypertrophy** or **acute ischemia**. Urinalysis abnormalities typical of renal involvement include RBCs, RBC casts, and **proteinuria**.

Diagnosis is based on the presence of a very high BP and findings of target-organ involvement.



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## Treatment

- Admit to ICU
- Short-acting IV drug: nitrate, fenoldopam, nicardipine, or labetalol
- Goal: 20 to 25% reduction MAP in 1 to 2 h

Hypertensive emergencies are treated in an ICU; BP is progressively (although not abruptly) reduced using a short-acting, titratable IV drug. Choice of drug and speed and degree of reduction vary somewhat with the target organ involved, but generally a 20 to 25% reduction in MAP over an hour or so is appropriate, with further titration based on symptoms. Achieving “normal” BP urgently is not necessary. Typical first-line drugs include nitroprusside, fenoldopam, nicardipine, and labetalol. Nitroglycerin alone is less potent.

Table 11

### Parenteral Drugs for Hypertensive Emergencies

Drug	Dose	Selected Adverse Effects*	Special Indications
Sodiumnitroprusside	0.25–10 µg/kg/min IV infusion <sup>†</sup> (maximum dose for 10 min only)	Nausea, vomiting, agitation, <b>muscle twitching</b> , sweating, <b>cutis anserina</b> (if BP is reduced too rapidly), thiocyanate and cyanide toxicity	Most hypertensive emergencies Should be used cautiously in patients with high intracranial pressure or azotemia
Nicardipine	5–15 mg/h IV	<b>Tachycardia</b> , headache, flushing, <b>local phlebitis</b>	Most hypertensive emergencies, except acute heart failure

			Should be used cautiously in patients with myocardial ischemia
Fenoldopam	0.1–0.3 µg/kg/min IV infusion; maximum dose 1.6 µg/kg/min	Tachycardia, headache, nausea, flushing, <b>hypokalemia</b> , elevation of <b>intraocular pressure</b> in patients with <b>glaucoma</b>	Most hypertensive emergencies Should be used cautiously in patients with myocardial ischemia
Nitroglycerin	5–100 µg/min IV infusion <sup>†</sup>	Headache, tachycardia, nausea, vomiting, apprehension, restlessness, muscular twitching, palpitations, <b>methemoglobinemia</b> , tolerance with prolonged use	Myocardial ischemia, heart failure
Enalaprilat	0.625–5 mg q 6 h IV	<b>Precipitous fall</b> in BP in high-renin states, variable response	Acute left ventricular failure Should be avoided in acute MI
Hydralazine	10–40 mg IV	Tachycardia,	Eclampsia

	10–20 mg IM	flushing, headache, vomiting, aggravation of angina	
Labetalol	20 mg IV bolus over 2 min, followed q 10 min by 40 mg, then up to 3 doses of 80 mg; or 0.5–2 mg/min IV infusion	Vomiting, scalp tingling, burning in throat, dizziness, nausea, heart block, <b>orthostatic hypotension</b>	Most hypertensive emergencies, except acute left ventricular failure  Should be avoided in patients with asthma
Esmolol	250–500 µg/kg/min for 1 min, then 50–100 µg/kg/min for 4 min; may repeat sequence	Hypotension, nausea	<b>Aortic dissection perioperatively</b>
Phentolamine	5–15 mg IV	Tachycardia, flushing, headache	Catecholamine excess

☐ \*Hypotension may occur with all drugs.

☐ †Requires a special delivery system (eg, infusion pump for nitroprusside, nonpolyvinyl chloride tubing for nitroglycerin).

Oral drugs are not indicated because onset is variable and the drugs are difficult to **titrate**. Although short-acting oral nifedipine reduces BP rapidly, it may lead to acute cardiovascular and cerebrovascular events (sometimes fatal) and is therefore not recommended.

Nitroprusside is a venous and arterial dilator, reducing preload and afterload; thus, it is the most useful for hypertensive patients with heart failure. It is also used for hypertensive encephalopathy and, with  $\beta$ -blockers, for aortic dissection. Starting dose is 0.25 to 1.0  $\mu\text{g}/\text{kg}/\text{min}$  titrated in increments of 0.5  $\mu\text{g}/\text{kg}$  to a maximum of 8 to 10  $\mu\text{g}/\text{kg}/\text{min}$ ; maximum dose is given for  $\leq 10$  min to minimize risk of cyanide toxicity. The drug is rapidly broken down into cyanide and nitric oxide (the active moiety). Cyanide is detoxified to thiocyanate. However, administration of  $> 2 \mu\text{g}/\text{kg}/\text{min}$  can lead to cyanide accumulation with toxicity to the CNS and heart; manifestations include agitation, seizures, cardiac instability, and **an anion gap metabolic acidosis**. Prolonged administration ( $> 1$  wk or, in patients with renal insufficiency, 3 to 6 days) leads to accumulation of thiocyanate, with lethargy, tremor, abdominal pain, and vomiting. Other adverse effects include **transitory elevation of hair follicles (cutis anserina)** if BP is reduced too rapidly. Thiocyanate levels should be monitored daily after 3 consecutive days of therapy, and the drug should be stopped if the serum thiocyanate level is  $> 12 \text{ mg}/\text{dL}$  ( $> 2 \text{ mmol}/\text{L}$ ). Because the drug is broken down by ultraviolet light, the IV bag and tubing are wrapped in an **opaque** covering.

Fenoldopam is a peripheral dopamine-1 agonist that causes systemic and renal **vasodilation** and **natriuresis**. Onset is rapid and half-life is brief, making it an effective alternative to nitroprusside, with the added benefit that it does not cross the blood-brain barrier. Initial dosage is 0.1  $\mu\text{g}/\text{kg}/\text{min}$  IV infusion, titrated upward by 0.1  $\mu\text{g}/\text{kg}$  q 15 min to a maximum of 1.6  $\mu\text{g}/\text{kg}/\text{min}$ .

Nitroglycerin is a vasodilator that affects veins more than arterioles. It can be used to manage hypertension during and after coronary artery bypass graft surgery, acute MI, unstable angina pectoris, and acute pulmonary edema. IV nitroglycerin is preferable to nitroprusside for patients with severe coronary artery disease because nitroglycerin increases coronary flow, whereas nitroprusside tends to decrease coronary flow to ischemic areas, possibly because of a “steal” mechanism. Starting dose is 10 to 20  $\mu\text{g}/\text{min}$  titrated upward by 10  $\mu\text{g}/\text{min}$  q 5 min to maximum antihypertensive effect. For long-term BP control, nitroglycerin must be used with other drugs. The most common adverse effect is headache (in about 2%); others include tachycardia, nausea, vomiting, apprehension, restlessness, muscular twitching, and palpitations.

Nicardipine, a dihydropyridine Ca channel blocker with less negative inotropic effects than nifedipine, acts primarily as a vasodilator. It is most often used for postoperative hypertension and during pregnancy. Dosage is 5 mg/h IV, increased q 15 min to a maximum of 15 mg/h. It may cause flushing, headache, and tachycardia; it can decrease GFR in patients with renal insufficiency.

Labetalol is a  $\beta$ -blocker with some  $\alpha_1$ -blocking effects, thus causing vasodilation without the typical accompanying reflex tachycardia. It can be given as a constant infusion or as frequent boluses; use of boluses has not been shown to cause significant hypotension. Labetalol is used during pregnancy, for intracranial disorders requiring BP control, and after MI. Infusion is 0.5 to 2 mg/min, titrated upward to a maximum of 4 to 5 mg/min. Boluses begin with 20 mg IV followed every 10 min by 40 mg, then 80 mg (up to 3 doses) to a maximum total of 300 mg. Adverse effects are minimal, but because of its  $\beta$ -blocking activity, labetalol should not be used for hypertensive emergencies in patients with asthma. Low doses may be used for left ventricular failure if nitroglycerin is given simultaneously.

Reference: <http://www.merckmanuals.com>