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HYPERTENSIVE CRISIS

- 62 yo M with a history of hypertension, normally on Lisinopril, presents to PCP for routine check-up. Patient with no complaints.
  - BP found to be **224/130 on check** in clinic.
  - PE normal.
  - Referred to ED for “hypertensive crisis”.

Case 1

- Patient had run out of Lisinopril and been off it for more than a week.
  - In ED, remained asymptomatic. Repeat BP 210/120.
  - PE normal.

Case 1

- Restarted on Lisinopril, referred back to PCP in a week for bp check
- In clinic later that week, BP 150/92.
- Started on second anti-hypertensive.

Case 1

- Generally considered to be a ***diastolic pressure >120 mmHg*** **(>180/120 mmHg)**

✓ hypertensive emergencies

✓ and hypertensive urgencies

Definition

DEFINITION

- **Hypertensive urgencies** are those situations associated with severe elevations in BP **without progressive target organ dysfunction**

JNC7

DEFINITION

- Hypertensive **emergencies** are characterized by severe elevations in BP complicated by evidence of **impending or progressive target organ dysfunction**.

JNC7

- **25 percent of all patient** visits to busy urban **emergency rooms**.(76% urgencies, 24% emergencies)

Epidemiology

- **Without antihypertensive therapy** approximately **7% of patient** with hypertension would **progress to hypertensive crisis**

- **Effective management** of chronic hypertension has lowered this rate to **<1%**

Epidemiology

- **One-year** and **5-year mortality** following untreated hypertensive **emergency** are **70% to 90%** and **100%**, respectively.

- With **adequate blood pressure control**, these mortality rates decrease to **25%** and **50%**, respectively.

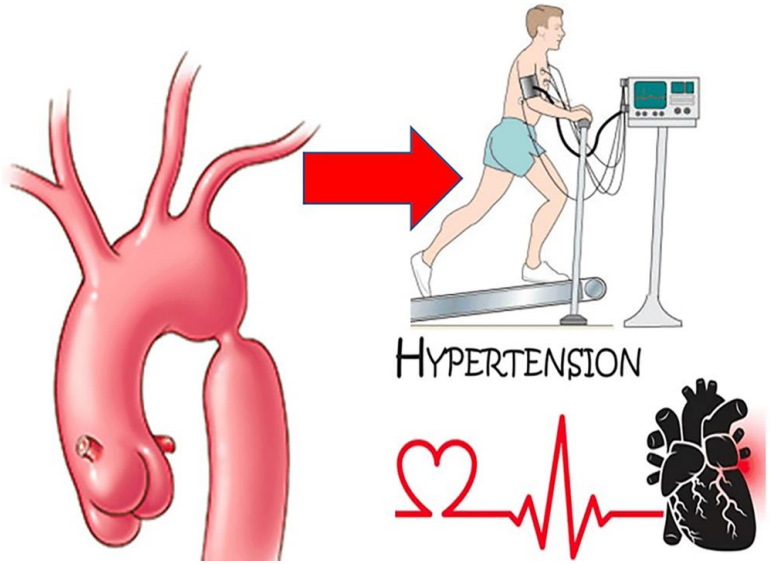
MORTALITY

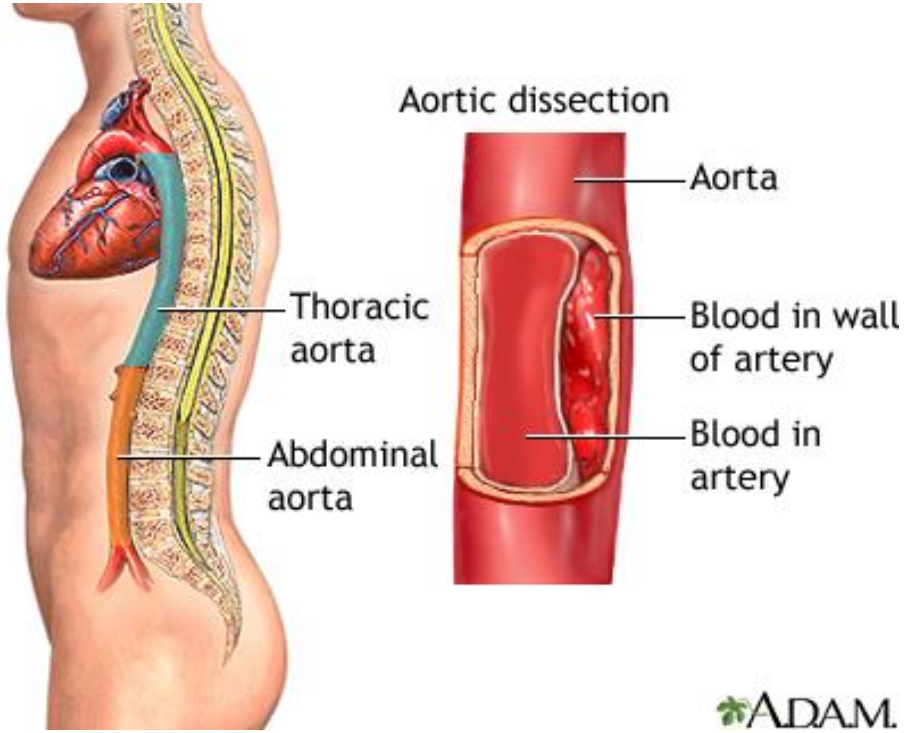
History of Hypertension

- In several studies of patients with hypertensive emergency, **a history of hypertension** was previously diagnosed in **>90% of the patients**, suggesting that hypertensive emergencies are **almost entirely preventable**

ETIOLOGY

- **Aortic dissection**
- **Aortic coarctation**





Etiology

- **Autonomic hyperactivity** (guillain barre syndrom)

- **Burns**

- **Cerebrovascular condition** (e.g., hypertensive encephalopathy, ischemic stroke, intracerebral hemorrhage, head injury)

Etiology

- **Drug induced hypertension** (e.g.,cocaine,amphetamines,MAOI,abrupt withdrawal of clonidine)

- **Endocrine** (e.g., pheochromocytoma, Cushing syndrome,primary aldestronism,excess glucocortioids)

- **Postoperative HTN**

Etiology

- **Pregnancy (**eclampsia, pre-eclampsia)
- **Renal disease (**e.g., acute glomeronephritis, renal artery stenosis, macroscopic polyarteritis, post renal transplantation)
- **Vasculatis**
- **Head injury**

Etiology

- **Drug–drug interactions** (including herbal medications)
- **Erythropoietin administration**
- **Drug–food interactions** (i.e., patients receiving monoamine oxidase inhibitors who ingest foods rich in tyramine)

Etiology

RRAS

- The pathophysiology of HC is **not well carectrized**
- **Renin-angiotension-aldestrone system**

Pathophysiology

CLINICAL PRESENTATION OF HYPERTENSIVE URGENCY

- The most frequently reported symptoms included:

- **Headache (42%)** and **dizziness (30%)**
- Other symptoms include **visual changes**, **chest discomfort**, **nausea**, **epistaxis**, **fatigue**, and **psychomotor agitation**

- It should be noted that ⟹ **not all patients** presenting with a hypertensive urgency **will have symptoms**

TREATMENT

✓ “Hypertensive urgency” → “uncontrolled blood pressure”

- **Avoid rapidly lowering blood pressure** → **hypotension** and **subsequent morbidity**

Hypertensive urgencies

- Reduction of BP to a safe level can occur more slowly over **24 to 48 hours**.
- **Oral** Versus Parenteral Therapy?

Hypertensive urgencies

- In adults with severe asymptomatic hypertension, the shorter-term goal of management is to reduce the blood pressure to ≤160/≤100 mmHg. However, the mean arterial pressure should not be lowered by **more than 25 to 30 percent over the first several hours**

- Patients judged to be at high risk for imminent cardiovascular events due to severe hypertension, including those with known **aortic or intracranial aneurysms**, should have their blood pressure lowered over a period of hours

- Captopril, enalapril, sublingual NTG, nifedipine, IV furosemide, losartan

- What's your idea?

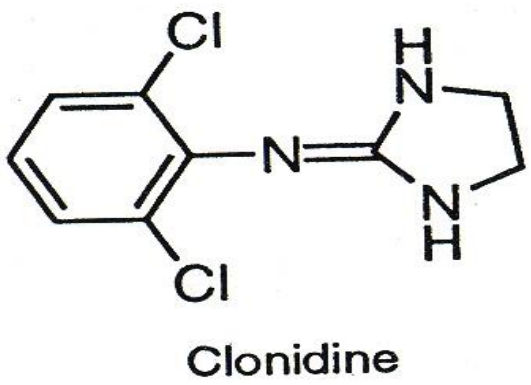
- Clonidine, Labetalol, Minoxidil, and Captopril have all been used to lower BP acutely

Oral Drugs Commonly Used in the Treatment of Hypertensive Urgencies

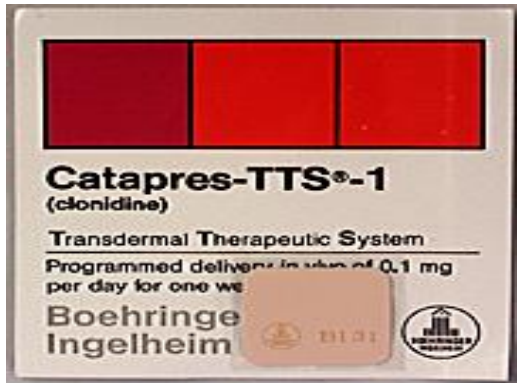
Drug[a] (Brand Name)	Dose/Route	Onset of Action	Duration of Action	Major Side Effects[a]	Mechanism of Action	Avoid or Use Cautiously in Patients With These Conditions
Captopril[b] (Capoten) 12.5-, 25-, 50-, 100-mg tablets	6.5–50 mg PO	15 minutes	4–6 hours	Hyperkalemia, angioedema, increased BUN if dehydrated, rash, pruritus, proteinuria, loss of taste	ACE inhibitor	Renal artery stenosis, hyperkalemia, dehydration, renal failure, pregnancy
Clonidine (Catapres) 0.1-, 0.2-, 0.3-mg tablets	0.1–0.2 mg PO initially, then 0.1 mg/h up to 0.8 mg total	0.5–2 hours	6–8 hours	Sedation, dry mouth, constipation	Central α_2-agonist	Altered mental status, severe carotid artery stenosis
Labetalol (Normodyne, Trandate) 100-, 200-, 300-mg tablets	200–400 mg PO repeated every 2–3 hours	30 minutes–2 hours	4 hours	Orthostatic hypotension, nausea, vomiting	α- and β-adrenergic blocker	Heart failure, asthma, bradycardia
Minoxidil (Loniten) 2.5-, 10-mg tablets	5–20 mg PO	30–60 minutes; maximum response in 2–4 hours	12–16 hours	Tachycardia, fluid retention	Arterial and venous vasodilator	Angina, heart failure

[a] All may cause hypotension, dizziness, and flushing.
[b] Other oral ACE inhibitors too slow in onset to be useful but should be used for maintenance therapy to improve adherence as captopril requires multiple daily doses
ACE, angiotensin-converting enzyme; BUN, blood urea nitrogen; PO, orally.

- Effective **first-line** therapy for hypertensive urgency



Clonidine



CLONIDINE

- Oral **loading dose** (**0.1–0.2 mg**)
- Followed by repeated doses of **0.1 mg/hour** → desired response or cumulative dose of **0.5 to 0.8 mg**

- Significant reduction in BP → within **1 hour**
- MAP → ↓ **25%** in most patients after several hours

Dosing

- **Sequential loading doses** → **caution**
  - **lack of benefit over placebo** and the potential for **unpredictable adverse effects**, particularly **abrupt occurrences of hypotension**.

- The **acute response to oral clonidine loading** is **not predictive of the daily dose** required to maintain acceptable BP control.

- **2-3 times daily** dosing → due to the short half-life.

- **Reduce loading doses** → **volume depletion**, **recent use of other antihypertensive drugs**, and the **elderly**

ADVERSE EFFECTS

- Orthostatic hypotension
- Bradycardia
- Sedation
- Dry mouth
- Dizziness

- Clonidine **should not be used** in patients in whom **mental status** is an important monitoring parameter
- Can **decrease cerebral blood flow** by up to 28%, it **should not be used** in patients with severe **cerebrovascular disease**

- Should be **avoided** in:
  - Patients with **HF**, **bradycardia**, **sick sinus syndrome**, or **cardiac conduction defects**
  - As well as patients at risk for medication **nonadherence**

- **Orally** or **sublingually?**
- May be given sublingually, but **no therapeutic advantage demonstrated**

CAPTOPRIL

Captopril

- **Peaks** → **30 to 90 minutes** after ingestion
- **Onset** → **within 10 to 15 minutes**

- Effects **persisting** for **2 to 6 hours**

Captopril

- **Sublingual captopril** → as effective as **nifedipine** in acutely reducing MAP in both urgent and emergent conditions

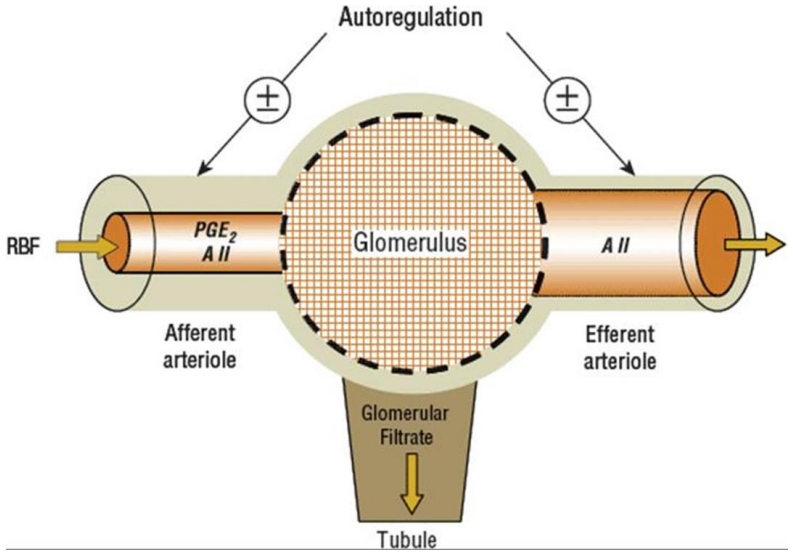
- **Caution** → **renal insufficiency** or **volume depletion**

Captopril

- First-dose hypotension or AKI → ?

Captopril

First-dose hypotension or AKI



↓

High renin levels

↓

Volume depletion or diuretics therapy

↓

Initial doses should not exceed **12.5 mg**

Other ACEIs

- Oral ACE inhibitors, **other than captopril**, are **not useful** for acutely lowering BP because their **onset of action** is too slow?

- The **most appropriate dosing regimen**?
- **Initial doses** → 100 to 300 mg may provide a sustained response for **up to 4 hours**.
- Labetalol (200 mg given at hourly intervals to a maximum dose of 1,200 mg) was **comparable to oral clonidine** in reducing mean arterial pressure

Oral Labetalol

- An alternative regimen using **300 mg initially** followed by **100 mg at 2-hour intervals** to a **maximum** of **500 mg** was also successful in acutely lowering BP.
  - However, **Wright et al** were **unable** to **achieve** an **adequate BP response** in a small series of patients using a single loading dose of **200** to **400** mg

Warnings and precautions

- ✓ **Orthostatic hypotension** → supine position
- ✓ Before ambulation → check for orthostasis
- ✓ Should be avoided in patients with **ASTHMA**, **BRADYCARDIA**, or **ADVANCED HEART BLOCK**

- **Onset of action is slower** than that of **clonidine** or **captopril**
- **β-blockers** and loop diuretics generally must be used concomitantly ?

- Minoxidil should be used only in patients presenting with hypertensive urgency who are **not responding to other antihypertensive therapies** or who have **previously been taking this agent**

Nifedipine

- Nifedipine → **“bite and swallow”**

Nifedipine

- Peripheral vasodilation. This reduces coronary perfusion, induces a **reflex tachycardia**, and increases myocardial oxygen consumption → **ischemia, MI, and stroke**

✓ Decreases cerebral blood flow

Nifedipine

- Elderly patients with underlying coronary or cerebrovascular disease
  - volume depletion
  - concurrent use of other antihypertensive drugs

Predisposing Factors

HYPERTENSIVE EMERGENCIES

- **Similar to hypertensive urgencies**, hypertensive emergencies **rarely develop in patients without a previous history of hypertension**

History of Hypertension

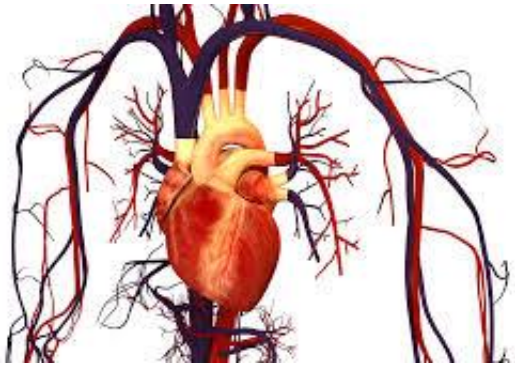
- **History of hypertension** was previously diagnosed in ***more than 90% of the patients***, suggesting that hypertensive emergencies are **almost entirely preventable**

History of Hypertension in more than 90% of patients

- The **primary sites of damage** are the **central nervous system**, **heart**, **kidneys**, and **eyes**

TARGET ORGAN DYSFUNCTION

- The **CNS**, **Cardiovascular** and **Renal system** are most affected



End Organ Dysfunction

- **Central nervous system (CNS) abnormalities were the most frequently reported:**

- Cerebral infarctions were noted in 24%
- Encephalopathy in 16%
- Intracranial or subarachnoid hemorrhage in 4% of patients.

End Organ Dysfunction

- Acute heart failure and pulmonary edema were seen in 36% of patients
- Acute myocardial infarction and unstable angina in 12% of patients.
- **Acute dissection** was noted in **2%**
- **Eclampsia** in 4.5% of patients.

End Organ Dysfunction

EVALUATION AND DIAGNOSIS

- The history and physical examination
  - Patients presenting with a severely elevated blood pressure (or an acute rise in blood pressure over a previously normal baseline, even if the presenting pressure is <180/120 mmHg) should determine whether any of the following are present:

- **Acute head injury** or trauma

- **Generalized neurologic symptoms**,
  - agitation, delirium, stupor, seizures, or visual disturbances

- FND
  - Focal neurologic symptoms that could be due to an ischemic or hemorrhagic stroke

- Fresh flame hemorrhages, exudates (cotton-wool spots), or papilledema
  - when direct fundoscopy is performed, as these are consistent with grade III or IV hypertensive retinopathy and can rarely be associated with hypertensive encephalopathy

- **Nausea and vomiting**
  - which may be a sign of increased intracranial pressure

- **Chest discomfort or pain**
  - which may be due to myocardial ischemia or aortic dissection

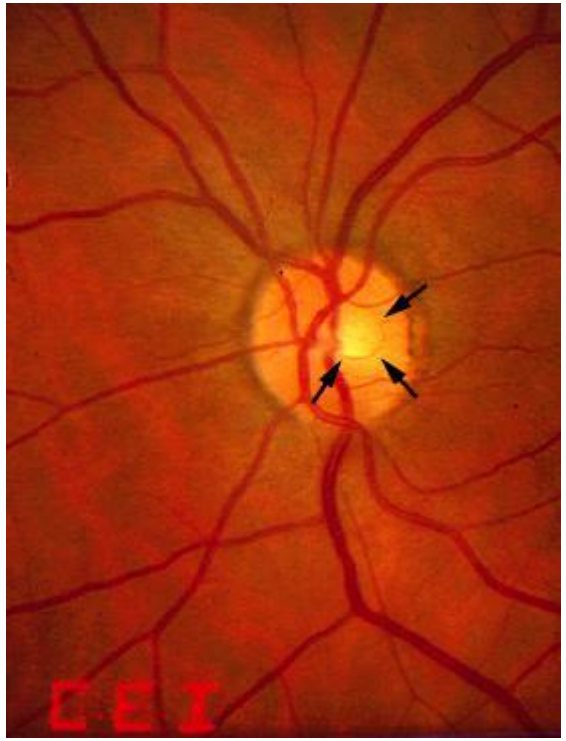
- **Acute, severe back pain**
  - which might be due to aortic dissection

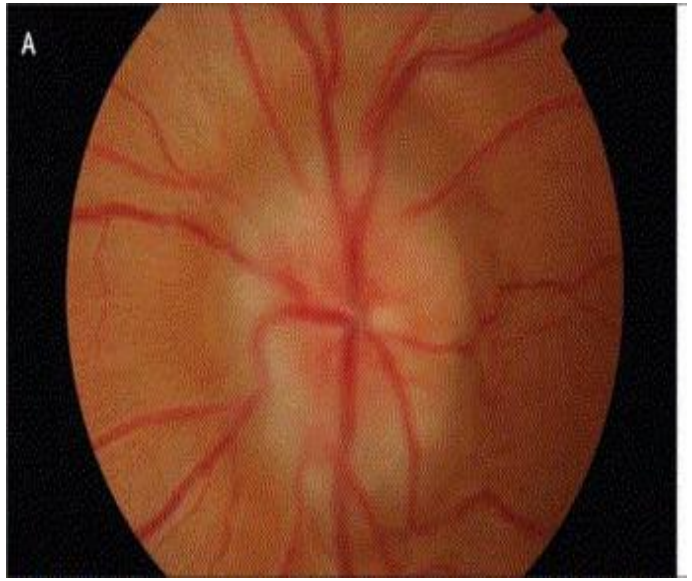
- **Dyspnea**
  - which may be due to pulmonary edema

- **Pregnancy**
  - preeclampsia or develop eclampsia

- **Drugs**
  - cocaine, amphetamine(s), phencyclidine, or monoamine oxidase inhibitors, or recent discontinuation of clonidine or, less commonly, other antihypertensive agents

Accelerated-malignant hypertension with papilloedema





- Immediate hospitalization, generally in an ICU
- Oral Versus **Parenteral Therapy**?

Principles of Treatment

- Effective therapy greatly improves the **prognosis**, **reverses symptoms**, and **arrests the progression** of end organ damage.

- Treatment **reverses the vascular changes** in the eyes and slows or arrests the progressive **deterioration in renal function**

Principles of Treatment

- Whether treatment can completely reverse end organ damage is related to two factors:

I. **How soon treatment is begun**

II. The **extent of damage** at the initiation of therapy

Principles of Treatment

- There are **two fundamental concepts** in the management of hypertensive emergencies:

- **FIRST**: **Immediate and intensive therapy** is required

- **SECOND**: **The choice of drugs** will depend on how their time course of action and hemodynamic and metabolic effects meet the needs of a crisis situation.

Principles of Treatment

- ✓ If **encephalopathy**, **acute left ventricular failure**, **dissecting aortic aneurysm**, **eclampsia**, or other serious conditions are present, the BP should be lowered promptly with **rapid-acting, parenteral** antihypertensive medications

The BP should be lowered promptly

TABLE 21-2

Parenteral Drugs Commonly Used in the Treatment of Hypertensive Emergencies

Drug (Brand Name)	Class of Drug	Dose/Route	Onset of Action	Duration of Action
Clevidipine (Cleviprex) 0.5 mg/mL	Arterial vasodilator (calcium-channel blocker)	Initial: 1–2 mg/h; titrate dose to desired BP or to a max of 16 mg/h	2–4 minutes	10–15 minutes after D/C
Enalaprilat[a] (Vasotec IV) 1.25 mg/mL, 2.5 mg/2 mL	ACE inhibitor	0.625–1.25 mg IV every 6 hours	15 minutes (max, 1–4 hours)	6–12 hours
Esmolol[b] (Brevibloc) 100 mg/10 mL, 2,500 mg/10 mL concentrate	β-adrenergic blocker	250–500 mcg/kg for 1 minute, then 50–300 mcg/kg/min	1–2 minutes	10–20 minutes
Fenoldopam (Corlopam) 10 mg/mL, 20 mg/2 mL, 50 mg/5 mL	Dopamine-1 agonist	0.1–0.3 mcg/kg/min	<5 minutes	30 minutes
Hydralazine[c] (generic) 20 mg/mL	Arterial vasodilator	10–20 mg IV	5–20 minutes	2–6 hours
Labetalol[d] (Normodyne) 20 mg/4 mL, 40 mg/8 mL, 100 mg/20 mL, 200 mg/20 mL	α- and β-adrenergic blocker	2 mg/min IV or 20–80 mg every 10 minutes up to 300 mg total dose	2–5 minutes	3–6 hours
Nicardipine[e] (Cardene IV) 25 mg/10 mL	Arterial vasodilator (calcium-channel blocker)	IV loading dose 5 mg/h increased by 2.5 mg/h every 5 minutes to desired BP or a max of 15 mg/h every 15 minutes, followed by maintenance infusion of 3 mg/h	2–10 minutes (max, 8–12 hours)	40–60 minutes after D/C infusion
Nitroglycerin[f] (Tridil, Nitro-Bid IV, Nitro-Stat IV) 5 mg/mL, 5 mg/10 mL, 25 mg/5 mL, 50 mg/10 mL, 100 mg/20 mL	Arterial and venous vasodilator	IV infusion pump 5–100 mcg/min	2–5 minutes	5–10 minutes after D/C infusion
Nitroprusside[g] (Nitropress), 50 mg/2 mL (most commonly used)	Arterial and venous vasodilator	IV infusion.[a] Start: 0.5 mcg/kg/min Usual: 2–5 mcg/kg/min Max: 8 mcg/kg/min	Seconds	3–5 minutes after D/C infusion
Phentolamine (Regitine)	α-adrenergic blocker	1–5 mg IV initially, repeat as needed	Immediate	10–15 minutes

Rate of BP lowering

- The rate of BP lowering must be **individualized**
- Elderly and patients with severely defective autoregulatory mechanisms (autonomic dysfunction or fixed sclerotic stenosis of cerebral or neck arteries) ⟹ hypotension complications

- Chronically elevated BP ⟹ hypertensive encephalopathy, cerebral hypoperfusion may occur if the mean BP is reduced by >40%

Principles of Treatment

- initially by no more than 25% (within minutes to 1 hour), then if stable → 160/100 mmHg within 2 to 6 hours and gradual reduction to normal → over the next 8 to 24 hours.

OR

- Target blood pressure of <180/<120 mmHg for the first hour and <160/<110 mmHg for the next 23 hours

Principles of Treatment

- A diastolic pressure of 100 to 110 mmHg is an appropriate initial therapeutic goal

✓ **Exceptions:**

✓ **Aortic Dissection**

✓ **Acute Cerebrovascular Accidents**

✓ **Acute spontaneous ICH**

✓ Exceptions:

I. Aortic Dissection

The **systolic blood pressure** should be rapidly lowered to a target of 100 to 120 mmHg (to be attained in **20 minutes**) to reduce aortic shearing forces

II. Acute Cerebrovascular Accidents:

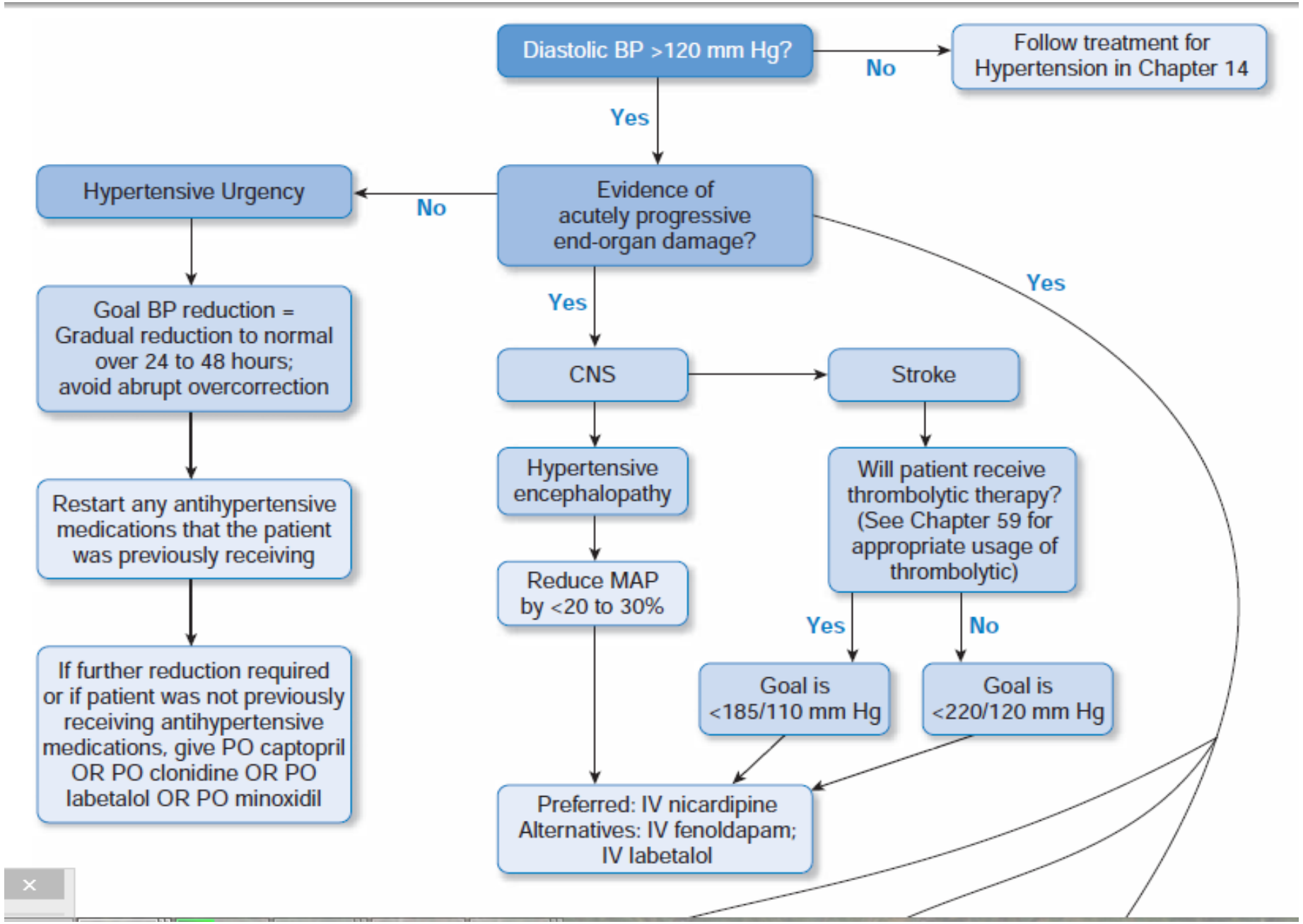
- following acute ischemic stroke in the presence of end organ damage if the blood pressure is <220/120 mmHg in patients ineligible for thrombolytic therapy or <185/110 mmHg in those who are candidates for thrombolytics

✓ **Exception:**

I. Acute spontaneous ICH

- Patients with acute ICH who present with **SBP** between **150 and 220 mmHg**
  - lowering of SBP to a target of 140 mmHg, ideally within the first one hour of presentation, provided the patient remains clinically stable.

- Patients with acute ICH who present with **SBP >220 mmHg**
  - we suggest rapid lowering of SBP to <220 mmHg. Thereafter, the blood pressure is gradually reduced (over a period of hours) to a target range of 140 to 160 mmHg, provided the patient remains clinically stable.


Diastolic BP >120 mm Hg?
No
Follow treatment for Hypertension in Chapter 14
Yes
Hypertensive Urgency
No
Evidence of acutely progressive end-organ damage?
Yes
Goal BP reduction = Gradual reduction to normal over 24 to 48 hours; avoid abrupt overcorrection
Yes
CNS
Stroke
Restart any antihypertensive medications that the patient was previously receiving
Hypertensive encephalopathy
Will patient receive thrombolytic therapy? (See Chapter 59 for appropriate usage of thrombolytic)
Reduce MAP by <20 to 30%
Yes
No
If further reduction required or if patient was not previously receiving antihypertensive medications, give PO captopril OR PO clonidine OR PO labetalol OR PO minoxidil
Goal is <185/110 mm Hg
Goal is <220/120 mm Hg
Preferred: IV nicardipine
Alternatives: IV fenoldapam; IV labetalol

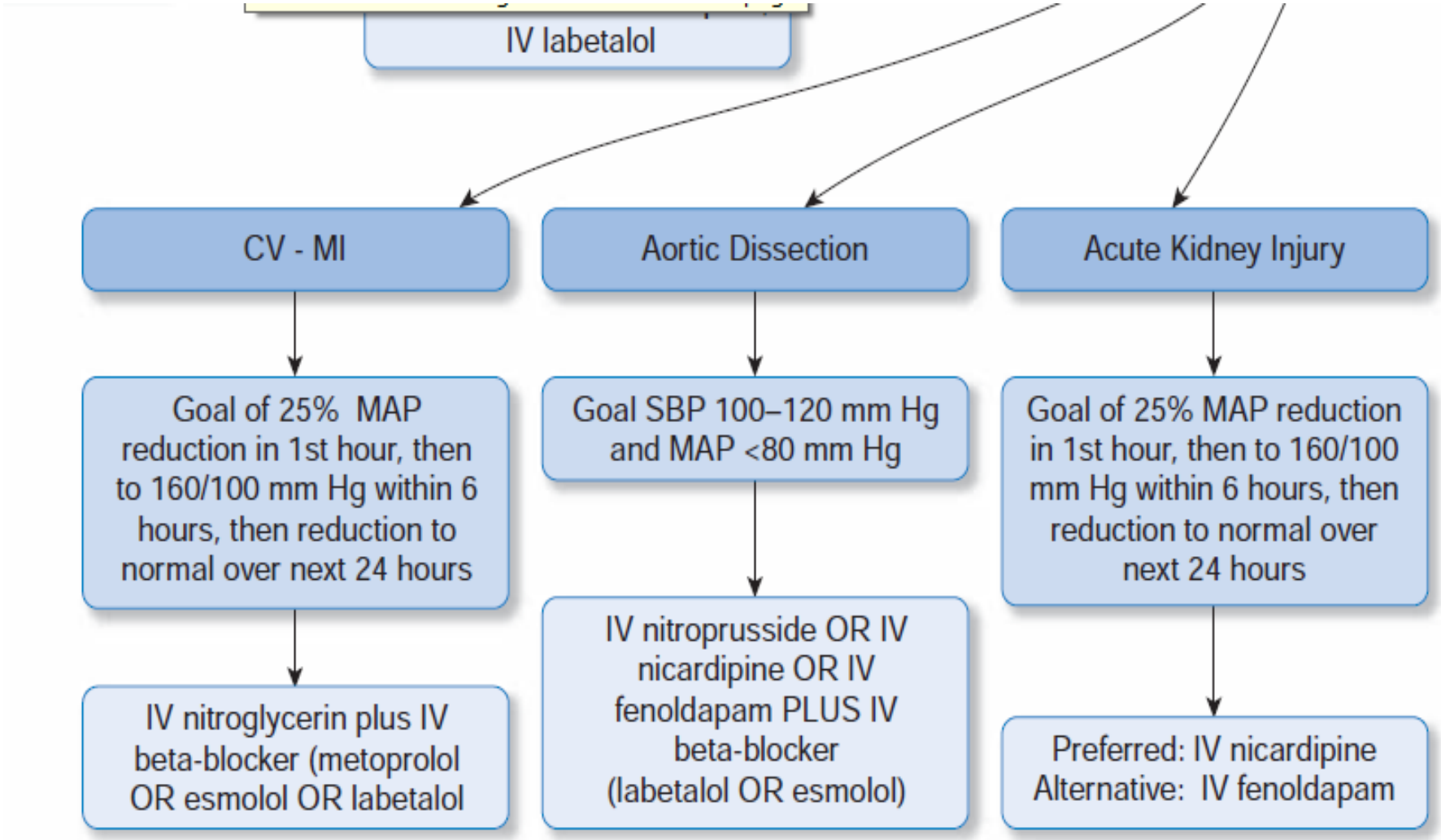
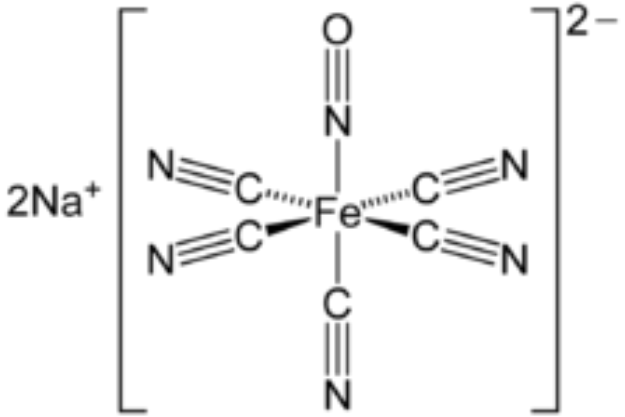

IV labetalol
CV - MI
Aortic Dissection
Acute Kidney Injury
Goal of 25% MAP reduction in 1st hour, then to 160/100 mm Hg within 6 hours, then reduction to normal over next 24 hours
IV nitroglycerin plus IV beta-blocker (metoprolol OR esmolol OR labetalol
Goal SBP 100–120 mm Hg and MAP <80 mm Hg
IV nitroprusside OR IV nicardipine OR IV fenoldapam PLUS IV beta-blocker (labetalol OR esmolol)
Goal of 25% MAP reduction in 1st hour, then to 160/100 mm Hg within 6 hours, then reduction to normal over next 24 hours
Preferred: IV nicardipine
Alternative: IV fenoldapam

TABLE 21-4

Treatment Recommendations for Hypertensive Emergency

Clinical Presentation	Recommendation	Rationale
Aortic dissection	Nitroprusside, nicardipine, or fenoldopam plus esmolol or IV metoprolol; labetalol; trimethaphan. Avoid inotropic therapy.	Vasodilator will decrease pulsatile stress in aortic vessel to prevent further dissection expansion. β-blockers will prevent vasodilator-induced reflex tachycardia.
Angina, myocardial infarction	Nitroglycerin plus esmolol or metoprolol; labetalol. Avoid nitroprusside.	Coronary vasodilation, decreased cardiac output, myocardial workload, and oxygen demand. Nitroprusside may cause coronary steal.
Acute pulmonary edema, left ventricular failure	Nitroprusside, nicardipine, or fenoldopam plus nitroglycerin and a loop diuretic. Alternative: enalaprilat. Avoid nondihydropyridines, β-blockers.	Promotion of diuresis with venous dilatation to decrease preload. Nitroprusside, enalaprilat decrease afterload. Nicardipine may increase stroke volume.
Acute kidney injury	Nicardipine or fenoldopam. Avoid nitroprusside, enalaprilat.	Peripheral vasodilation without renal clearance. Fenoldopam shown to increase renal blood flow.
Cocaine overdose	Nicardipine, fenoldopam, verapamil, or nitroglycerin. Alternative: labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation. CCBs control overdose-induced vasospasm.
Pheochromocytoma	Nicardipine, fenoldopam, or verapamil. Alternatives: phentolamine, labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation.
Hypertensive encephalopathy, intracranial hemorrhage, subarachnoid hemorrhage, thrombotic stroke	Nicardipine, fenoldopam, or labetalol. Avoid nitroprusside, nitroglycerin, enalaprilat, hydralazine.	Vasodilation effects without compromised CBF induced by nitroprusside and nitroglycerin. Enalaprilat and hydralazine may lead to unpredictable BP changes when carefully controlled BP management is required.

Nitroprusside



Nitroprusside

Table 20-4 Treatment Recommendations for Hypertensive Crises

Clinical Presentation	*Recommendation*	*Rationale*
Aortic dissection	Nitroprusside, nicardipine, or fenoldopam plus esmolol or IV metoprolol; labetalol; trimethaphan. Avoid inotropic therapy.	Vasodilator will decrease pulsatile stress in aortic vessel to prevent further dissection expansion. β-blockers will prevent vasodilator-induced reflex tachycardia.
Angina, myocardial infarction	Nitroglycerin plus esmolol or metoprolol; labetalol. Avoid nitroprusside.	Coronary vasodilation, decreased cardiac output, myocardial workload, and oxygen demand. Nitroprusside may cause coronary steal.
Acute pulmonary edema, left ventricular failure	Nitroprusside, nicardipine, or fenoldopam plus nitroglycerin and a loop diuretic. Alternative: enalaprilat. Avoid nondihydropyridines, β-blockers.	Promotion of diuresis with venous dilatation to decrease preload. Nitroprusside, enalaprilat decrease afterload. Nicardipine may increase stroke volume.
Acute renal failure	Nicardipine or fenoldopam. Avoid nitroprusside, enalaprilat.	Peripheral vasodilation without renal clearance. Fenoldopam shown to increase renal blood flow.
Cocaine overdose	Nicardipine, fenoldopam, verapamil, or nitroglycerin. Alternative: labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation. CCBs control overdose-induced vasospasm.
Pheochromocytoma	Nicardipine, fenoldopam, or verapamil. Alternatives: phentolamine, labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation.
Hypertensive encephalopathy, intracranial hemorrhage, subarachnoid hemorrhage, thrombotic stroke	Nicardipine, fenoldopam, or labetalol. Avoid nitroprusside, nitroglycerin, enalaprilat, hydralazine.	Vasodilation effects without compromised CBF induced by nitroprusside and nitroglycerin. Enalaprilat and hydralazine may lead to unpredictable BP changes when carefully controlled BP management is required.

- ✓ easily titratable
- ✓ *Onset of Action* ⟹ Sec
- ✓ *Duration of Action* ⟹ 3–5 min after D/C infusion
- ✓ Low cost
- ➢ cyanide or thiocyanate toxicity

- Extreme potency → exact concentrations precisely calculated rates using a controlled infusion device → BP must be closely monitored

- the solution should be shielded with an opaque sleeve but It is **not necessary** to protect the **tubing** from light

- Reconstituted solutions are stable for 24 hours at room temperature
- A change in the solution's color  discarded

- Relatively **ineffective** in the acute treatment of hypertension except in patients with concomitant volume overload or HF

  - Renal failure aggravation and profound hypotension

  - ✓ **Venodilation or diuresis?**

Concurrent Use of Diuretics

- Peripheral dopamine-1 agonist
  - ↑ Renal blood flow → advantageous in patients with impaired renal function.
- No document that this effect reduces morbidity and mortality in patients with severe hypertension

Fenoldopam

Fenoldopam

- More expensive than, sodium nitroprusside
- Only as an alternative to nitroprusside in patients who are at high risk for cyanide or thiocyanate toxicity.

Fenoldopam

- The vasodilating effect may also cause flushing, dizziness, and headache
  - dose-dependent increase in intraocular pressure(IOP) → should be used cautiously in patients with glaucoma or intraocular hypertension

Adverse Effects

- Labetalol blocks both β- and α-adrenergic receptors and also may exert a direct vasodilator effect.
- The β-blockade is nonselective with β to α potency of **3:1 for oral** and **7:1 for IV** labetalol without causing reflex tachycardia does not significantly reduce cerebral blood flow

Labetalol

Labetalol

- Uncontrolled HF
- Raynaud's syndrome
- **Mask** the symptoms of **hypoglycemia** in insulin-dependent diabetic patients

Precautions

Labetalol

- Asthma
- Heart block greater than first degree
- Sinus bradycardia

Contraindications

Labetalol

- However, because labetalol is primarily a β-blocker, paradoxical hypertension may occur in patients with **pheochromocytoma**?

Nitroglycerin

- ↓Myocardial oxygen consumption ⇒ Unstable angina or MI and coronary bypass surgery
- Nitroprusside? **coronary steal?**

Nitroglycerin

Clinical Presentation	Recommendation	Rationale
Aortic dissection	Nitroprusside, nicardipine, or fenoldopam plus esmolol or IV metoprolol; labetalol; trimethaphan. Avoid inotropic therapy.	Vasodilator will decrease pulsatile stress in aortic vessel to prevent further dissection expansion. β-blockers will prevent vasodilator-induced reflex tachycardia.
Angina, myocardial infarction	Nitroglycerin plus esmolol or metoprolol; labetalol. Avoid nitroprusside.	Coronary vasodilation, decreased cardiac output, myocardial workload, and oxygen demand. Nitroprusside may cause coronary steal.
Acute pulmonary edema, left ventricular failure	Nitroprusside, nicardipine, or fenoldopam plus nitroglycerin and a loop diuretic. Alternative: enalaprilat. Avoid nondihydropyridines, β-blockers.	Promotion of diuresis with venous dilatation to decrease preload. Nitroprusside, enalaprilat decrease afterload. Nicardipine may increase stroke volume.
Acute renal failure	Nicardipine or fenoldopam. Avoid nitroprusside, enalaprilat.	Peripheral vasodilation without renal clearance. Fenoldopam shown to increase renal blood flow.
Cocaine overdose	Nicardipine, fenoldopam, verapamil, or nitroglycerin. Alternative: labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation. CCBs control overdose-induced vasospasm.
Pheochromocytoma	Nicardipine, fenoldopam, or verapamil. Alternatives: phentolamine, labetalol. Avoid β-selective blockers.	Vasodilation effects without potential unopposed α-adrenergic receptor stimulation.
Hypertensive encephalopathy, intracranial hemorrhage, subarachnoid hemorrhage, thrombotic stroke	Nicardipine, fenoldopam, or labetalol. Avoid nitroprusside, nitroglycerin, enalaprilat, hydralazine.	Vasodilation effects without compromised CBF induced by nitroprusside and nitroglycerin. Enalaprilat and hydralazine may lead to unpredictable BP changes when carefully controlled BP management is required.

BP, blood pressure; CBF, cerebral blood flow; CCB, calcium channel blocker; IV, intravenous.

- Rapid onset of action and a short duration
  - Start: 5 to 10 mcg/minute
  - usual dose → 40 to 100 mcg/minute
  - Headache and the development of tolerance → major limiting side effects

- should be used only in patients who:

I. Cannot tolerate labetalol (e.g., asthma or advanced heart block)

II. Require a more gradual lowering of BP than that produced by nitroprusside

III. Require a more rapid and certain drop in BP than that which can be produced by oral antihypertensive agents

Diazoxide

I. Coronary heart disease → reflex tachycardia

II. Aortic dissection → reflex cardiostimulating effect

Contraindications

- ✓ Hypertensive emergencies induced by catecholamine excess (pheochromocytoma)
- The onset of action is almost immediate and the duration of action is short (<15 minutes)
- IV infusions are not recommended → due to the risk of causing hypotension

Intravenous Phentolamine

- ✓ The treatment of choice → has classically been a vasodilatory agent (sodium nitroprusside, fenoldopam, or nicardipine) + a β-blocker titrated to a heart rate of 55 to 65 beats/minute
  - Labetalol monotherapy → alternative

Aortic Dissection

- ✓ Nicardipine, Verapamil, or IV Nitroglycerin
- ❑ Calcium channels blockers and IV nitroglycerin are preferred in patients with active myocardial ischemia because they have both been shown to reverse cocaine-induced hypertension and vasoconstriction
- ❑ Fenoldopam and Nitroprusside can be used as alternative agents

Cocaine-induced Hypertension

- Benzodiazepines → can attenuate the effect of cocaine on the cardiac system

Benzodiazepines

- β-blockers should be avoided in patients with hypertension or myocardial ischemia/MI with recent cocaine use
- Labetalol → caution → ↑ seizure in animals

TABLE 21-4

Treatment Recommendations for Hypertensive Emergency

Clinical Presentation	Recommendation	Rationale
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THANK YOU