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ACLS Core Drugs

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Administration Notes

Peripheral IV:	Resuscitation drugs administered via peripheral IV catheter should be followed by bolus of 20 mL IV fluid to move drug into central circulation. Then elevate extremity for 10 to 20 seconds.
Intraosseous:	ACLS drugs that can be administered by IV route can be administered by intraosseous (IO) route.
Endotracheal:	Drugs that can be administered by endotracheal route are indicated. Optimal endotracheal doses have not yet been established. IV/IO administration is preferred because it provides more reliable drug delivery and pharmacologic effect. Medication delivered via endotracheal tube should be diluted in water or NS to a volume of 10 mL. Provide several positive-pressure breaths after medication is instilled.

Drug/Therapy	Indications/Precautions	Adult Dosage
ACE Inhibitors (Angiotensin-Converting Enzyme Inhibitors)	**Indications** • ACE inhibitors reduce mortality and improve LV dysfunction in post-AMI patients. They help prevent adverse LV remodeling, delay progression of heart failure, and decrease sudden death and recurrent MI. • An ACE Inhibitor should be administered orally within the first 24 hours after onset of symptoms and continued long term. • Clinical heart failure without hypotension in patients not responding to digitalis or diuretics. • Clinical signs of AMI with LV dysfunction. • LV ejection fraction <40%.	**Approach**: ACE inhibitor therapy should start with low-dose oral administration (with possible IV doses for some preparations) and increase steadily to achieve a full dose within 24 to 48 hours. An angiotensin receptor blocker (ARB) should be administered to patients intolerant of ACE inhibitors.
Enalapril	**Precautions/Contraindications for All ACE Inhibitors** • ***Contraindicated*** in pregnancy (may cause fetal injury or death). • Contraindicated in angioedema. • Hypersensitivity to ACE inhibitors. • Reduce dose in renal failure (creatinine >2.5 mg/dL in men, >2 mg/dL in women). Avoid in bilateral renal artery stenosis. • Serum potassium >5 mEq/L • Do not give if patient is hypotensive (SBP <100 mm Hg or more than 30 mm Hg below baseline) or volume depleted. • Generally not started in ED; after reperfusion therapy has been completed and blood pressure has stabilized, start within 24 hours.	**Enalapril (IV=Enalaprilat)** • PO: Start with a single dose of 2.5 mg. Titrate to 20 mg PO BID. • IV: 1.25 mg IV initial dose over 5 minutes, then 1.25 to 5 mg IV every 6 hours. • IV form is contraindicated in STEMI (risk of hypotension).
Captopril		**Captopril, AMI Dose** • Start with a single dose of 6.25 mg PO. • Advance to 25 mg TID and then to 50 mg TID as tolerated.
Lisinopril		**Lisinopril, AMI Dose** • 5 mg within 24 hours of onset of symptoms, then • 5 mg given after 24 hours, then • 10 mg given after 48 hours, then • 10 mg once daily
Ramipril		**Ramipril** • Start with a single dose of 2.5 mg PO. Titrate to 5 mg PO BID as tolerated.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Adenosine	**Indications** • First drug for most forms of stable narrow-complex PSVT. Effective in terminating those due to reentry involving AV node or sinus node. • May consider for unstable narrow-complex reentry tachycardia while preparations made for cardioversion. • Wide-complex regular tachycardia, thought to be or previously defined to be, reentry SVT. • Does *not* convert atrial fibrillation, atrial flutter, or VT. • Undefined, stable narrow-complex SVT as a diagnostic maneuver. **Precautions/Contraindications** • **Contraindication:** Poison/drug-induced tachycardia or second- or third-degree heart block. • Transient side effects include flushing, chest pain or tightness, brief periods of asystole or bradycardia, ventricular ectopy. • Less effective (larger doses may be required) in patients taking theophylline or caffeine; reduce dose to 3 mg in patients receiving dipyridamole or carbamazepine. • If administered for wide-complex tachycardia/VT, may cause deterioration (including hypotension). • Transient periods of sinus bradycardia and ventricular ectopy are common after termination of SVT. • Safe and effective in pregnancy.	**IV Rapid Push** • Place patient in mild reverse Trendelenburg position before administration of drug. • Initial bolus of 6 mg given *rapidly* over 1 to 3 seconds followed by NS bolus of 20 mL; then elevate the extremity. • A second dose (12 mg) can be given in 1 to 2 minutes if needed. • A third dose (12 mg) may be given in 1 to 2 minutes if needed. **Injection Technique** • Record rhythm strip during administration. • Draw up adenosine dose and flush in 2 separate syringes. • Attach both syringes to the IV injection port closer to patient. • Clamp IV tubing above injection port. • Push IV adenosine *as quickly as possible* (1 to 3 seconds). • While maintaining pressure on adenosine plunger, push NS flush *as rapidly as possible* after adenosine. • Unclamp IV tubing.
Amiodarone	**Indications** Because of its potentially life-threatening side effects and the difficulties associated with managing its use, amiodarone should be prescribed for the treatment of only the following documented, life-threatening, recurrent ventricular arrhythmias when these arrhythmias have not responded to other antiarrhythmic agents or when alternative agents have not been tolerated: • Recurrent ventricular fibrillation • Recurrent hemodynamically unstable ventricular tachycardia Patients must be hospitalized while the loading doses of amiodarone are administered. Amiodarone should be prescribed only by physicians who are experienced in the treatment of life-threatening arrhythmias, thoroughly familiar with amiodarone's risks and benefits, and have access to laboratory facilities capable of adequately monitoring the effectiveness and side effects of amiodarone treatment. **Other Uses: Seek Expert Consultation** **Caution: Multiple complex drug interactions**	**Cardiac Arrest Unresponsive to CPR, Shock, and Vasopressors** 300 mg IV/IO push (recommend dilution in 20 to 30 mL D_5W). Initial dose can be followed by ONE 150 mg IV push in 3 to 5 minutes. **Recurrent Life-Threatening Ventricular Arrhythmias** *Maximum cumulative dose:* 2.2 g IV/24 h. May be administered as follows: • *Rapid infusion:* 150 mg IV over first 10 minutes (15 mg/min). May repeat rapid infusion (150 mg IV) every 10 minutes as needed. • *Slow infusion:* 360 mg IV over 6 hours (1 mg/min). • *Maintenance infusion:* 540 mg IV over 18 hours (0.5 mg/min). **Precautions** • With multiple dosing, cumulative doses >2.2 g/24 hours are associated with significant hypotension in clinical trials. • Do not administer with other drugs that prolong QT interval (eg, procainamide). • Terminal elimination is extremely long (half-life lasts up to 40 days).

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Drug/Therapy	Indications/Precautions	Adult Dosage
Amrinone *(See Inamrinone)*		
Aspirin	**Indications** • Administer to all patients with ACS, particularly reperfusion candidates, unless hypersensitive to aspirin. • Blocks formation of thromboxane A_2, which causes platelets to aggregate and arteries to constrict. This reduces overall ACS mortality, reinfarction, nonfatal stroke. • Any person with symptoms ("pressure," "heavy weight," "squeezing," "crushing") suggestive of ischemic pain. **Precautions** • Relatively contraindicated in patients with active ulcer disease or asthma. • Contraindicated in patients with known hypersensitivity to aspirin.	• 160 mg to 325 mg nonenteric coated tablet as soon as possible (chewing is preferable). • May use rectal suppository (300 mg) for patients who cannot take PO. • Goal: Give within minutes of arrival.
Atropine Sulfate Can be given via endotracheal tube Administration should not delay pacing for severely symptomatic patients	**Indications** • First drug for symptomatic sinus bradycardia. • May be beneficial in presence of AV nodal block or ventricular asystole. **Will not be effective for infranodal (Mobitz type II) block.** • Second drug (after epinephrine or vasopressin) for asystole or bradycardic pulseless electrical activity. • Organophosphate (eg, nerve agent) poisoning: extremely large doses may be needed. **Precautions** • Use with caution in presence of myocardial ischemia and hypoxia. Increases myocardial oxygen demand. • Avoid in hypothermic bradycardia. • Will not be effective for infranodal (type II) AV block and new third-degree block with wide QRS complexes. (In these patients may cause paradoxical slowing. Be prepared to pace or give catecholamines.) • Doses of atropine <0.5 mg may result in paradoxical slowing of heart rate.	**Asystole or Pulseless Electrical Activity** • 1 mg IV/IO push. • May repeat every 3 to 5 minutes (if asystole persists) to a maximum of 3 doses (3 mg). **Bradycardia** • 0.5 mg IV every 3 to 5 minutes as needed, not to exceed total dose of 0.04 mg/kg (total 3 mg). • Use shorter dosing interval (3 minutes) and higher doses in severe clinical conditions. **Acute Coronary Syndromes** ACC/AHA STEMI Guidelines recommend 0.6 to 1 mg IV repeated every 5 minutes for ACS patients (total dose 0.04 mg/kg). **Endotracheal Administration** • 2 to 3 mg diluted in 10 mL water or NS. **Organophosphate Poisoning** Extremely large doses (2 to 4 mg or higher) may be needed.

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Drug/Therapy	Indications/Precautions	Adult Dosage
β-Blockers	**Indications**	
Metoprolol tartrate	• Administer to all patients with suspected myocardial infarction and unstable angina in the absence of contraindication. These are effective antianginal agents and can reduce incidence of VF. • Useful as an adjunctive agent with fibrinolytic therapy. May reduce nonfatal reinfarction and recurrent ischemia.	**Metoprolol tartrate (AMI regimen)** • Initial IV dose: 5 mg slow IV at 5-minute intervals to a total of 15 mg. • Oral regimen to follow IV dose: 50 mg BID for 24 hours, then increase to 100 mg BID.
Atenolol	• To convert to normal sinus rhythm or to slow ventricular response (or both) in supraventricular tachyarrhythmias (PSVT, atrial fibrillation, or atrial flutter). β-Blockers are second-line agents (with calcium channel blockers) after adenosine. • To reduce myocardial ischemia and damage in AMI patients with elevated heart rate, blood pressure, or both.	**Atenolol (AMI regimen)** • 5 mg slow IV (over 5 minutes). • Wait 10 minutes, then give second dose of 5 mg slow IV (over 5 minutes). • In 10 minutes, if tolerated well, may start 50 mg PO; then give 50 mg PO q 12 h × 2, then 100 mg daily.
Propranolol	• For emergency antihypertensive therapy for hemorrhagic and acute ischemic stroke. **Precautions/Contraindications** • Concurrent IV administration with IV calcium channel blocking agents like verapamil or diltiazem can cause severe hypotension.	**Propranolol** • Total dose: 0.1 mg/kg by slow IV push, divided into 3 equal doses at 2- to 3-minute intervals. Do not exceed 1 mg/min. • Repeat in 2 minutes after total dose is given if necessary.
Esmolol	• Avoid in bronchospastic diseases, cardiac failure, or severe abnormalities in cardiac conduction. • Monitor cardiac and pulmonary status during administration. • May cause myocardial depression. • Contraindicated in presence of severe bradycardia, SBP <100 mm Hg, severe LV failure, hypoperfusion, or second- or third-degree AV block. • Propranolol is contraindicated in cocaine-induced ACS.	**Esmolol** • 0.5 mg/kg over 1 minute, followed by 4-minute infusion at 50 µg/kg (0.05 mg/kg) per minute; maximum: 0.3 mg/kg per minute for a total of 200 µg/kg. • If initial response inadequate, second 0.5 mg/kg bolus over one minute, then increase infusion to 100 µg/kg per minute; max infusion rate 300 µg/kg (0.3 mg/kg) per minute. • Esmolol has a short half-life (2 to 9 minutes).
Labetalol		**Labetalol** • 10 mg labetalol IV push over 1 to 2 minutes. • May repeat or double labetalol every 10 minutes to a maximum dose of 150 mg, *or* give initial dose as a bolus, then start labetalol infusion at 2 to 8 mg/min.
Calcium Chloride 10% solution is 100 mg/mL in 10 mL	**Indications** • Known or suspected hyperkalemia (eg, renal failure). • Ionized hypocalcemia (eg, after multiple blood transfusions). • As an antidote for toxic effects (hypotension and arrhythmias) from calcium channel blocker overdose or β-blocker overdose. **Precautions** • Do not use routinely in cardiac arrest. • Do not mix with sodium bicarbonate.	**Typical Dose** • 500 mg to 1000 mg (5 to 10 mL of a 10% solution) IV for hyperkalemia and calcium channel blocker overdose. May be repeated as needed.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Cardioversion (Synchronized) Administered via adhesive defibrillation electrodes or handheld paddles from a defibrillator/monitor Place defibrillator/monitor in synchronized (sync) mode Sync mode delivers energy just after the R wave	**Indications** • All tachycardias (rate >150 bpm) with serious signs and symptoms related to the tachycardia. • May give brief trial of medications based on specific arrhythmias. **Precautions/Contraindications** • **Contraindications:** Poison/drug-induced tachycardia. • In critical conditions go to immediate unsynchronized shocks. • Urgent cardioversion is generally not needed if heart rate is ≤150 bpm. • Reactivation of sync mode is required after each attempted cardioversion (defibrillators/cardioverters default to unsynchronized mode). • Prepare to defibrillate immediately if cardioversion causes VF. • Synchronized cardioversion cannot be performed unless the patient is connected to monitor leads; lead select switch must be on lead I, II, or III and not on "paddles."	**Technique** • Premedicate whenever possible. • Engage sync mode before each attempt. • Look for sync markers on the R wave. • Clear the patient before each shock. • Reentry SVT and atrial flutter often respond to lower energy levels; start with 50 J to 100 J. If initial dose fails, increase in stepwise fashion. • For atrial fibrillation, use 100 to 200 J initial monophasic shock, or 100 to 120 J initial (selected) biphasic shock, and then increase in stepwise fashion. • Deliver monophasic shocks in the following sequence: 100 J, 200 J, 300 J, 360 J. Use this sequence for monomorphic VT. • Treat unstable polymorphic VT (irregular form and rate) with high-energy *unsynchronized* dose used for VF: 360 J monophasic waveform or biphasic device-specific defibrillation dose. • Press "charge" button, "clear" the patient, and press both "shock" buttons simultaneously. Be prepared to perform CPR or defibrillation.
Clopidogrel	**Indications** • Give as soon as possible to all patients with high-risk ST-segment depression or dynamic T-wave inversion (NSTEMI and UA) in absence of contraindications if — In-hospital conservative approach is planned **or** — Cardiac catheterization and PCI are planned and the risk for bleeding is not high • Patients who have undergone catheterization with planned PCI. • Used for antiplatelet therapy; especially useful for patients who cannot tolerate ASA. **Precautions** • Do not administer to patients with active pathologic bleeding (eg, peptic ulcer). Use with caution in patients with risk of bleeding. • Use with caution in the presence of hepatic impairment. • **Do not administer in ACS if CABG planned within 5 to 7 days.**	**Dose** • Initial dose 300 mg PO, followed by 75 mg PO q day for 1 to 9 months; full effects will not develop for several days.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Defibrillation Single Shock Sequence, Resume CPR Immediately Use conventional monitor/defibrillator (ACLS provider) Use automated or shock advisory defibrillator (AED)—lay rescuer and BLS healthcare provider Administer shocks via remote adhesive electrodes or handheld paddles	**Indications** First intervention for VF or pulseless VT. **Precautions** • Always "clear" the patient before discharging a defibrillation shock. • Do not delay defibrillation for VF/VT if witnessed arrest and defibrillator is available. • EMS providers who do not witness arrest may provide 5 cycles (about 2 minutes) of CPR before attempting defibrillation. • Do not shock asystole. • Treat VF/VT in hypothermic cardiac arrest with an initial defibrillation shock. Repeat shocks for VF/VT only after core temperature rises above 30°C. • If patient in VF/VT has an automatic implantable cardioverter defibrillator (AICD), perform external defibrillation per BLS section. If AICD is delivering shocks, wait 30 to 60 seconds for completion of cycle. • If patient has implanted device (eg pacer, AICD), place paddles and pads at least 1 inch (2.5 cm) from the device.	**Adult Monophasic Defibrillation Energy Levels** • 360 J for first and subsequent monophasic shocks. **Manual Biphasic Defibrillator** • Use device-specific dose, typically selected energy of 120 J (rectilinear) or 150 J (truncated) to 200 J. • If unknown, use 200 J. Subsequent shocks: same or higher energy. **Following Single Shock** • Resume CPR, beginning with chest compressions, for 5 cycles or about 2 minutes, then reanalyze rhythm, deliver another shock, resume CPR. • If first 2 shocks fail to convert VF/VT, administer epinephrine or vasopressin. • If these medications fail to convert VF/VT, consider antiarrhythmic medications. ***Note:*** When using AED pads, do not use child pads or child attenuator system for adult defibrillation. ***Note:*** Use adult pads and dose when child is 8 years of age and older, over 25 kg (55 pounds), or over 50 inches in length. Refer to PALS section of *Handbook*.
Digibind (Digoxin-Specific Antibody Therapy) 40 mg vial (each vial binds about 0.6 mg digoxin)	**Indications** Digoxin toxicity with the following: • Life-threatening arrhythmias. • Shock or congestive heart failure. • Hyperkalemia (potassium level >5 mEq/L). • Steady-state serum levels >10 to 15 ng/mL for symptomatic patients. **Precautions** • Serum digoxin levels rise after digibind therapy and should not be used to guide continuing therapy.	**Chronic Intoxication** 3 to 5 vials may be effective. **Acute Overdose** • IV dose varies according to amount of digoxin ingested. • Average dose is 10 vials (400 mg); may require up to 20 vials (800 mg). • See package insert for details.
Digoxin 0.25 mg/mL or 0.1 mg/mL supplied in 1 or 2 mL ampule (totals = 0.1 to 0.5 mg)	**Indications (may be of limited use)** • To slow ventricular response in atrial fibrillation or atrial flutter. • Alternative drug for reentry SVT. **Precautions** • Toxic effects are common and are frequently associated with serious arrhythmias. • Avoid electrical cardioversion if patient is receiving digoxin unless condition is life-threatening; use lower dose (10 to 20 J).	**IV Administration** • Loading doses of 10 to 15 µg/kg lean body weight provide therapeutic effect with minimum risk of toxic effects. • Repeat digoxin levels no sooner than 4 hours with IV dose; no sooner than 6 hours after oral dose. • Maintenance dose is affected by body mass and renal function. • Caution: Amiodarone interaction. Reduce digoxin dose by 50% when initiating amiodarone.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Diltiazem	**Indications** • To control ventricular rate in atrial fibrillation and atrial flutter. May terminate reentrant arrhythmias that require AV nodal conduction for their continuation. • Use after adenosine (second-line agent) to treat refractory reentry SVT in patients with narrow QRS complex and adequate blood pressure. **Precautions** • Do not use calcium channel blockers for wide-QRS tachycardias of uncertain origin or for poison/drug-induced tachycardia. • Avoid calcium channel blockers in patients with Wolff-Parkinson-White syndrome plus rapid atrial fibrillation or flutter, in patients with sick sinus syndrome, or in patients with AV block without a pacemaker. • Caution: Blood pressure may drop from peripheral vasodilation (greater drop with verapamil than with diltiazem). • Avoid in patients receiving oral β-blockers. • Concurrent IV administration with IV β-blockers can cause severe hypotension.	**Acute Rate Control** • 15 to 20 mg (0.25 mg/kg) IV over 2 minutes. • May give another IV dose in 15 minutes at 20 to 25 mg (0.35 mg/kg) over 2 minutes. **Maintenance Infusion** 5 to 15 mg/h, titrated to physiologically appropriate heart rate (can dilute in D_5W or NS).
Dobutamine *IV infusion*	**Indications** • Consider for pump problems (congestive heart failure, pulmonary congestion) with systolic blood pressure of 70 to 100 mm Hg and *no* signs of shock. **Precautions/Contraindication** • **Contraindication:** Suspected or known poison/drug-induced shock. • Avoid with systolic blood pressure <100 mm Hg and signs of shock. • May cause tachyarrhythmias, fluctuations in blood pressure, headache, and nausea. • Do not mix with sodium bicarbonate.	**IV Administration** • Usual infusion rate is 2 to 20 μg/kg per minute. • Titrate so heart rate does not increase by >10% of baseline. • Hemodynamic monitoring is recommended for optimal use. • Elderly patients may have a significantly decreased response.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Dopamine *IV infusion*	**Indications** • Second-line drug for symptomatic bradycardia (after atropine). • Use for hypotension (systolic blood pressure ≤70 to 100 mm Hg) with signs and symptoms of shock. **Precautions** • Correct hypovolemia with volume replacement before initiating dopamine. • Use with caution in cardiogenic shock with accompanying CHF. • May cause tachyarrhythmias, excessive vasoconstriction. • Do not mix with sodium bicarbonate.	**IV Administration** • Usual infusion rate is 2 to 20 µg/kg per minute. • Titrate to patient response, taper slowly.
Epinephrine Can be given via endotracheal tube Note: Available in 1:10 000 and 1:1000 concentrations	**Indications** • **Cardiac arrest:** VF, pulseless VT, asystole, pulseless electrical activity. • **Symptomatic bradycardia:** Can be considered after atropine as an alternative infusion to dopamine. • **Severe hypotension:** Can be used when pacing and atropine fail, when hypotension accompanies bradycardia, or with phosphodiesterase enzyme inhibitor. • **Anaphylaxis, severe allergic reactions:** Combine with large fluid volumes, corticosteroids, antihistamines. **Precautions** • Raising blood pressure and increasing heart rate may cause myocardial ischemia, angina, and increased myocardial oxygen demand. • High doses do not improve survival or neurologic outcome and may contribute to postresuscitation myocardial dysfunction. • Higher doses *may* be required to treat poison/drug-induced shock.	**Cardiac Arrest** • **IV/IO Dose:** 1 mg (10 mL of 1:10 000 solution) administered every 3 to 5 minutes during resuscitation. Follow each dose with 20 mL flush, elevate arm for 10 to 20 seconds after dose. • **Higher Dose:** Higher doses (up to 0.2 mg/kg) may be used for specific indications (β-blocker or calcium channel blocker overdose) • **Continuous Infusion:** Add 1 mg epinephrine (1 mL of 1:1000 solution) to 500 mL NS or D_5W. Initial infusion rate of 1 µg/min titrated to effect (typical dose: 2 to 10 µg/min). • **Endotracheal Route** 2 to 2.5 mg diluted in 10 mL NS. **Profound Bradycardia or Hypotension** 2 to 10 µg/min infusion; titrate to patient response.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Fibrinolytic Agents	**Indications** *For Cardiac Arrest: Insufficent evidence to recommend routine use.* *For AMI in Adults:* • ST elevation (>1 mm in ≥2 contiguous leads) or new or presumably new LBBB. • In context of signs and symptoms of AMI. • Time from onset of symptoms ≤12 hours. *For Acute Ischemic Stroke:* (Alteplase is the only fibrinolytic agent approved for acute ischemic stroke.) • Sudden onset of focal neurologic deficits or alterations in consciousness (eg, facial droop, arm drift, abnormal speech). • Absence of intracerebral or subarachnoid hemorrhage or mass effect on CT scan. • Absence of variable or rapidly improving neurologic deficits. • Alteplase can be started in <3 hours from symptom onset. **Precautions and Exclusion Criteria** • Active internal bleeding (except menses) within 21 days. • History of cerebrovascular, intracranial, or intraspinal event within 3 months (stroke, arteriovenous malformation, neoplasm, aneurysm, recent trauma, recent surgery). • Major surgery or serious trauma within 14 days. • Aortic dissection. • Severe, uncontrolled hypertension. • Known bleeding disorders. • Prolonged CPR with evidence of thoracic trauma. • Lumbar puncture within 7 days. • Recent arterial puncture at noncompressible site. • During the first 24 hours of fibrinolytic therapy for ischemic stroke, do not administer aspirin or heparin.	**Alteplase, recombinant (tPA)** Recommended total dose is based on patient's weight. For AMI the total dose should not exceed 100 mg; for acute ischemic stroke the total dose should not exceed 90 mg. Note that there is a dose regimen for STEMI patients and a *different* regimen for acute ischemic stroke. *For AMI:* • Accelerated infusion (1.5 hours) — Give 15 mg IV bolus. — Then 0.75 mg/kg over next 30 minutes (not to exceed 50 mg). — Then 0.5 mg/kg over 60 minutes (not to exceed 35 mg). *For Acute Ischemic Stroke:* • Give 0.9 mg/kg (maximum 90 mg) infused over 60 minutes. • Give 10% of the total dose as an initial IV bolus over 1 minute. • Give the remaining 90% over the next 60 minutes.
Alteplase, recombinant *(Activase); tissue plasminogen activator (tPA)* 50 and 100 mg vials reconstituted with sterile water to 1 mg/mL For all 4 agents, use 2 peripheral IV lines, one line exclusively for fibrinolytic administration		
Reteplase, recombinant *(Retavase)* 10 U vials reconstituted with sterile water to 1 U/mL		**Reteplase, recombinant** • Give first 10 U IV bolus over 2 minutes. • 30 minutes later give second 10 U IV bolus over 2 minutes. (Give NS flush before and after each bolus.) • Give heparin and aspirin conjunctively.
Streptokinase *(Streptase)* Reconstitute to 1 mg/mL		**Streptokinase** 1.5 million U in a 1-hour infusion.
Tenecteplase *(TNKase)*		**Tenecteplase** Bolus: 30 to 50 mg, weight adjusted.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Flumazenil	**Indications** Reverse respiratory depression and sedative effects from pure benzodiazepine overdose. **Precautions** • Effects may not outlast effect of benzodiazepines. • Monitor for recurrent respiratory depression. • Do not use in suspected tricyclic overdose. • Do not use in seizure-prone patients. • Do not use in unknown drug overdose or mixed drug overdose with drugs known to cause seizures (tricyclic antidepressants, cocaine, amphetamines, etc).	**First Dose** 0.2 mg IV over 15 seconds. **Second Dose** 0.3 mg IV over 30 seconds. If no adequate response, give third dose. **Third Dose** 0.5 mg IV given over 30 seconds. If no adequate response, repeat once every minute until adequate response or a total of 3 mg is given.
Furosemide	**Indications** • For adjuvant therapy of acute pulmonary edema in patients with systolic blood pressure >90 to 100 mm Hg (without signs and symptoms of shock). • Hypertensive emergencies. • Increased intracranial pressure. **Precautions** Dehydration, hypovolemia, hypotension, hypokalemia, or other electrolyte imbalance may occur.	**IV Administration** • 0.5 to 1 mg/kg given over 1 to 2 minutes. • If no response, double dose to 2 mg/kg, slowly over 1 to 2 minutes. • For new onset pulmonary edema with hypovolemia: <0.5 mg/kg.
Glucagon Powdered in 1 and 10 mg vials Reconstitute with provided solution	**Indications** Adjuvant treatment of toxic effects of calcium channel blocker or β-blocker. **Precautions** • Do not mix with saline. • May cause vomiting, hyperglycemia.	**IV Infusion** 3 mg initially followed by infusion at 3 mg/hour as necessary.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Glycoprotein IIb/IIIa Inhibitors	**Indications** These drugs inhibit the integrin glycoprotein IIb/IIIa receptor in the membrane of platelets, inhibiting platelet aggregation. Indicated for acute coronary syndromes *without* ST-segment elevation. **Precautions/Contraindications** Active internal bleeding or bleeding disorder in past 30 days, history of intracranial hemorrhage or other bleeding, surgical procedure or trauma within 1 month, platelet count <150 000/mm^3, hypersensitivity and concomitant use of another GP IIb/IIIa inhibitor (also see "ACS: Treatment for UA/NSTEMI").	**Note: Check package insert for current indications, doses, and duration of therapy.** Optimal duration of therapy has not been established.
Abciximab (ReoPro®)	**Abciximab Indications** FDA-approved for patients with NSTEMI or unstable angina with planned PCI within 24 hours. **Precautions/Contraindications** Must use with heparin. Binds irreversibly with platelets. Platelet function recovery requires 48 hours (regeneration). Readministration may cause hypersensitivity reaction.	**Abciximab** • **Acute coronary syndromes with planned PCI within 24 hours:** 0.25 mg/kg IV bolus (10 to 60 minutes before procedure), then 0.125 µg/kg per minute IV infusion for 12 to 24 hours. • **PCI only:** 0.25 mg/kg IV bolus, then 10 µg/min IV infusion.
Eptifibatide (Integrilin®)	**Eptifibatide Indications** Unstable angina/NSTEMI managed medically, and unstable angina/NSTEMI patients undergoing PCI. **Actions/Precautions** Platelet function recovers within 4 to 8 hours after discontinuation.	**Eptifibatide** • **Acute coronary syndromes:** 180 µg/kg IV bolus over 1 to 2 minutes, then 2 µg/kg per minute IV infusion for 72 to 96 hours. • **PCI:** 180 µg/kg IV bolus over 1 to 2 minutes, then begin 2 µg/kg per minute IV infusion, then repeat bolus in 10 minutes. • Maximum dose (121 kg patient) for ACS/PCI: 22.6 mg bolus; 15 mg/h infusion. • Adjust dose if creatinine clearance <50 mL/min.
Tirofiban (Aggrastat®)	**Tirofiban Indications** Unstable angina/NSTEMI managed medically, and unstable angina/NSTEMI patients undergoing PCI. **Actions/Precautions** Platelet function recovers within 4 to 8 hours after discontinuation.	**Tirofiban** • **Acute coronary syndromes or PCI:** 0.4 µg/kg per minute IV for 30 minutes, then 0.1 µg/kg per minute IV infusion for 48 to 96 hours. • Adjust dose if creatinine clearance <30 mL/min.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Heparin **Unfractionated (UFH)** Concentrations range from 1000 to 40 000 IU/mL	**Indications** • Adjuvant therapy in AMI. • Begin heparin with fibrin-specific lytics (eg, alteplase, reteplase, tenecteplase). **Precautions** • Same contraindications as for fibrinolytic therapy: active bleeding; recent intracranial, intraspinal, or eye surgery; severe hypertension; bleeding disorders; gastrointestinal bleeding. • Doses and laboratory targets appropriate when used with fibrinolytic therapy. • Do not use if platelet count is or falls below <100 000 or with history of heparin-induced thrombocytopenia. For these patients consider direct antithrombins. See bivalirudin at the bottom of this column.	**UFH IV Infusion—STEMI** • Initial bolus 60 IU/kg (maximum bolus: 4000 IU). • Continue 12 IU/kg per hour, round to the nearest 50 IU (maximum: 1000 IU/hour for patients >70 kg). • Adjust to maintain aPTT 1.5 to 2 times the control values (about 50 to 70 seconds) for 48 hours or until angiography. • Check initial aPTT at 3 hours, then q 6 hours until stable, then daily. • Follow institutional heparin protocol. • Platelet count daily. **UFH IV Infusion—NSTEMI** • Initial bolus 60 to 70 IU/kg. Maximum: 5000 IU. • 12 to 15 IU/kg per hour. Maximum: 1000 IU/h. • Follow institutional protocol (see last 3 bullets under UFH IV Infusion—STEMI section).
Heparin **Low Molecular Weight (LMWH)** **Enoxaparin** (Lovenox®)	**Indications** For use in acute coronary syndromes, specifically patients with NSTEMI/unstable angina. These drugs inhibit thrombin generation by factor Xa inhibition and also inhibit thrombin indirectly by formation of a complex with antithrombin III. These drugs are **not** neutralized by heparin-binding proteins. **Precautions** • Hemorrhage may complicate any therapy with LMWH. Contraindicated in presence of hypersensitivity to heparin or pork products or history of sensitivity to drug. Use **enoxaparin** with extreme caution, in patients with type II heparin-induced thrombocytopenia. • Adjust dose for renal insufficiency. • Contraindicated if platelet count <100 000. For these patients consider direct antithrombins: — **Bivalirudin** (Angiomax, FDA-approved for ACS patients undergoing PCI): Bolus: 0.25 mg/kg IV infusion: 0.5 mg/kg per hour for 12 hours; then 0.25 mg/kg per hour for 36 hours. Decrease infusion rate if aPTT >75 seconds during first 12 hours.	**NSTEMI Enoxaparin Protocol** • 1 mg/kg SQ BID; the first dose may be preceded by 30 mg IV bolus. **STEMI Enoxaparin Protocol**—as ancillary therapy with fibrinolytic • 30 mg IV bolus, then 1 mg/kg SQ BID until hospital discharge. • For patients <75 years with no clinically significant renal insufficiency. • Contraindicated for creatinine >2.5 mg/dL in men or 2 mg/dL in women (when administered with tenecteplase). **Enoxaparin: Renal Insufficiency** For creatinine clearance <30 mL/min reduce dose to 1 mg/kg SQ QD. **Heparin Reversal** ICH or life-threatening bleed: Administer protamine, refer to package insert.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Ibutilide Intervention of choice is DC cardioversion	**Indications** Treatment of supraventricular arrhythmias, including atrial fibrillation and atrial flutter when duration ≤48 hours. Short duration of action. Effective for the conversion of atrial fibrillation or flutter of relatively brief duration. **Precautions/Contraindications** Contraindication: Do not give to patients with QT_C >440 msec. Ventricular arrhythmias develop in approximately 2% to 5% of patients (polymorphic ventricular tachycardia, including torsades de pointes). *Monitor ECG continuously for arrhythmias during administration and for 4 to 6 hours after administration with defibrillator nearby.* Patients with significantly impaired LV function are at highest risk for arrhythmias.	**Dose for Adults ≥60 kg** 1 mg (10 mL) administered IV (diluted or undiluted) over 10 minutes. A second dose may be administered at the same rate 10 minutes later. **Dose for Adults <60 kg** 0.01 mg/kg initial IV dose.
Inamrinone Phosphodiesterase enzyme inhibitor	**Indications** Severe congestive heart failure refractory to diuretics, vasodilators, and conventional inotropic agents. **Precautions** • Do not mix with dextrose solutions or other drugs. • May cause tachyarrhythmias, hypotension, or thrombocytopenia. • Can increase myocardial ischemia.	**IV Loading Dose and Infusion** • 0.75 mg/kg (not to exceed 1 mg/kg), given over 2 to 3 minutes. Give loading dose over 10 to 15 minutes with LV dysfunction (eg, postresuscitation). • Follow with infusion of 5 to 15 µg/kg per minute titrated to clinical effect. • Additional bolus may be given in 30 minutes. • Requires hemodynamic monitoring. • Creatinine clearance <10 mL/min: reduce dose 25% to 50%.
Isoproterenol IV infusion	**Indications** • *Use cautiously as temporizing measure if external pacer is not available* for treatment of symptomatic bradycardia. • Refractory torsades de pointes unresponsive to magnesium sulfate. • *Temporary* control of bradycardia in heart transplant patients (denervated heart unresponsive to atropine). • Poisoning from β-blockers. **Precautions** • Do not use for treatment of cardiac arrest. • Increases myocardial oxygen requirements, which may increase myocardial ischemia. • Do not give with epinephrine; can cause VF/VT. • Do not give to patients with poison/drug-induced shock (except for β-blocker poisoning). • May use higher doses for β-blocker poisoning.	**IV Administration** • Infuse at 2 to 10 µg/min. • Titrate to adequate heart rate. • In torsades de pointes titrate to increase heart rate until VT is suppressed.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Lidocaine Can be given via endotracheal tube	**Indications** • Alternative to amiodarone in cardiac arrest from VF/VT. • Stable monomorphic VT with preserved ventricular function. • Stable polymorphic VT with normal baseline QT interval and preserved LV function when ischemia is treated and electrolyte balance is corrected. • Can be used for stable polymorphic VT with baseline QT-interval prolongation if torsades suspected. **Precautions/Contraindications** • **Contraindication:** *Prophylactic* use in AMI is contraindicated. • Reduce maintenance dose (not loading dose) in presence of impaired liver function or left ventricular dysfunction. • Discontinue infusion immediately if signs of toxicity develop.	**Cardiac Arrest From VF/VT** • Initial dose: 1 to 1.5 mg/kg IV/IO. • For refractory VF may give additional 0.5 to 0.75 mg/kg IV push, repeat in 5 to 10 minutes; maximum 3 doses or total of 3 mg/kg. • Endotracheal administration: 2 to 4 mg/kg. **Perfusing Arrhythmia** For stable VT, wide-complex tachycardia of uncertain type, significant ectopy: • Doses ranging from 0.5 to 0.75 mg/kg and up to 1 to 1.5 mg/kg may be used. • Repeat 0.5 to 0.75 mg/kg every 5 to 10 minutes: maximum total dose: 3 mg/kg. **Maintenance Infusion** 1 to 4 mg/min (30 to 50 µg/kg per minute); can dilute in D_5W, $D_{10}W$, or NS.
Magnesium Sulfate	**Indications** • Recommended for use in cardiac arrest only if torsades de pointes or suspected hypomagnesemia is present. • Life-threatening ventricular arrhythmias due to digitalis toxicity. • Routine administration in hospitalized patients with AMI is **not** recommended. **Precautions** • Occasional fall in blood pressure with rapid administration. • Use with caution if renal failure is present.	**Cardiac Arrest (Due to Hypomagnesemia or Torsades de Pointes)** 1 to 2 g (2 to 4 mL of a 50% solution) diluted in 10 mL of D_5W IV/IO over 5 to 20 minutes. **Torsades de Pointes With a Pulse or AMI With Hypomagnesemia** • Loading dose of 1 to 2 g mixed in 50 to 100 mL of D_5W, over 5 to 60 minutes IV. • Follow with 0.5 to 1 g/h IV (titrate to control torsades).
Mannitol Strengths: 5%, 10%, 15%, 20%, and 25%	**Indications** Increased intracranial pressure in management of neurologic emergencies. **Precautions** • Monitor fluid status and serum osmolality (not to exceed 310 mOsm/kg). • Caution in renal failure because fluid overload may result.	**IV Administration** • Administer 0.5 to 1 g/kg over 5 to 10 minutes through in-line filter. • Additional doses of 0.25 to 2 g/kg can be given every 4 to 6 hours as needed. • Use with support of oxygenation and ventilation.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Milrinone Shorter half-life than inamrinone	**Indications** Myocardial dysfunction and increased systemic or pulmonary vascular resistance, including • Congestive heart failure in postoperative cardiovascular surgical patients • Shock with high systemic vascular resistance **Precautions** May produce nausea, vomiting, hypotension, particularly in volume-depleted patients. Shorter half-life and less effect on platelets, but more risk for ventricular arrhythmia than inamrinone. Drug may accumulate in renal failure and in patients with low cardiac output; reduce dose in renal failure.	**Loading Dose** 50 µg/kg over 10 minutes IV loading dose. **Intravenous Infusion** • 0.375 to 0.75 µg/kg per minute for 2 to 3 days. • Hemodynamic monitoring required. • Reduce dose in renal impairment.
Morphine Sulfate	**Indications** • Chest pain with ACS unresponsive to nitrates. • Acute cardiogenic pulmonary edema (if blood pressure is adequate). **Precautions** • Administer slowly and titrate to effect. • May cause respiratory depression. • Causes hypotension in volume-depleted patients. • Use with caution in right ventricular infarction. • May reverse with naloxone (0.4 to 2 mg IV).	**IV Administration** Initial dose: 2 to 4 mg IV (over 1 to 5 minutes) every 5 to 30 minutes. Repeat dose: 2 to 8 mg at 5- to 15-minute intervals.
Naloxone Hydrochloride	**Indications** Respiratory and neurologic depression due to opiate intoxication unresponsive to O_2 and support of ventilation. **Precautions** • May cause opiate withdrawal. • Half-life shorter than narcotics, repeat dosing may be needed. • Monitor for recurrent respiratory depression. • Rare anaphylactic reactions have been reported. • Assist ventilation before naloxone administration, avoid sympathetic stimulation. • Avoid in meperidine-induced seizures.	**Administration** • Typical dose 0.4 to 2 mg, titrate until ventilations adequate. • Use higher doses for complete narcotic reversal. • Can administer up to 6 to 10 mg over short period (<10 minutes). • IM/SQ 0.4 to 0.8 mg • For chronic opioid-addicted patients, use smaller dose and titrate slowly. • Can be given by endotracheal route if IV/IO access not available (other routes preferred).

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Drug/Therapy	Indications/Precautions	Adult Dosage
Nitroglycerin Available in IV form, sublingual tablets, and aerosol spray	**Indications** • Initial antianginal for suspected ischemic pain. • For initial 24 to 48 hours in patients with *AMI and CHF*, large anterior wall infarction, persistent or recurrent ischemia, or hypertension. • Continued use (beyond 48 hours) for patients with recurrent angina or persistent pulmonary congestion. • Hypertensive urgency with ACS. **Contraindications** • Hypotension (SBP <90 mm Hg or more than 30 mm Hg below baseline) • Severe bradycardia (<50 bpm) or tachycardia (>100 bpm) • RV infarction • Use of phosphodiesterase inhibitors for erectile dysfunction (eg, sildenafil and vardenafil within 24 hours; tadalafil within 48 hours) **Precautions** • With evidence of AMI, limit systolic blood pressure drop to 10% if patient is normotensive, 30% drop if hypertensive, and avoid drop below 90 mm Hg. • Do not mix with other drugs. • Patient should sit or lie down when receiving this medication. • Do not shake aerosol spray because this affects metered dose.	**IV Administration** • IV bolus: 12.5 to 25 µg (if no SL or spray given). • Infusion: Begin at 10 to 20 µg/min. Titrate to effect, increase by 5 to 10 µg/min every 5 to 10 minutes until desired effect. — Route of choice for emergencies. — Use appropriate IV sets provided by pharmaceutical companies. • Dilute in D_5W or NS. **Sublingual Route** 1 tablet (0.3 to 0.4 mg), repeated for total of 3 doses at 5-minute intervals. **Aerosol Spray** 1 to 2 sprays for 0.5 to 1 second at 5-minute intervals (provides 0.4 mg per dose). Maximum 3 sprays within 15 minutes. **Note:** Patients should be instructed to contact EMS if pain is unrelieved or increasing after one tablet or sublingual spray.
Nitroprusside (Sodium Nitroprusside)	**Indications** • Hypertensive crisis. • To reduce afterload in heart failure and acute pulmonary edema. • To reduce afterload in acute mitral or aortic valve regurgitation. **Precautions** • May cause hypotension, thiocyanate toxicity, and CO_2 retention. • May reverse hypoxic pulmonary vasoconstriction in patients with pulmonary disease, exacerbating intrapulmonary shunting, resulting in hypoxemia. • Other side effects include headaches, nausea, vomiting, and abdominal cramps. • Caution with phosphodiesterase inhibitors (eg, sildenafil).	**IV Administration** • Add 50 or 100 mg to 250 mL D_5W. (Refer to your institutional pharmacy policy.) • Begin at 0.1 µg/kg per minute and titrate upward every 3 to 5 minutes to desired effect (usually up to 5 µg/kg per minute but higher doses up to 10 µg/kg may be needed). • Use with an infusion pump; use hemodynamic monitoring for optimal safety. • Action occurs within 1 to 2 minutes. • Light-sensitive, cover drug reservoir and tubing with opaque material.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Norepinephrine	**Indications** • Severe cardiogenic shock and hemodynamically significant hypotension (systolic blood pressure <70 mm Hg) with low total peripheral resistance. • Agent of last resort for management of ischemic heart disease and shock. **Precautions** • Increases myocardial oxygen requirements, raises blood pressure and heart rate. • May induce arrhythmias. Use with caution in patients with acute ischemia; monitor cardiac output. • Extravasation causes tissue necrosis. • If extravasation occurs, administer phentolamine 5 to 10 mg in 10 to 15 mL saline solution, infiltrated into area.	**IV Administration (Only Route)** • 0.5 to 1 µg/min titrated to improve blood pressure (up to 30 µg/min). • Add 4 mg of norepinephrine or 8 mg of norepinephrine bitartrate to 250 mL of D_5W or D_5NS, but not NS alone. • Do not administer in same IV line as alkaline solutions. • Poison/drug-induced hypotension may require higher doses to achieve adequate perfusion.
Oxygen Delivered from portable tanks or installed, wall-mounted sources through delivery devices	**Indications** • Any suspected cardiopulmonary emergency. • Complaints of shortness of breath and suspected ischemic pain. • ACS: administer to all patients for first 6 hours. Continue if pulmonary congestion, ongoing ischemia, or oxygen saturation is <90%. • For patients with suspected stroke and hypoxemia or unknown oxyhemoglobin saturation. May consider administration to patients who are not hypoxemic. **Precautions** • Observe closely when using with pulmonary patients known to be dependent on hypoxic respiratory drive (very rare). • Pulse oximetry may be inaccurate in low cardiac output states, with vasoconstriction, or with carbon monoxide exposure.	

Device	Flow Rate	O_2 (%)
Nasal cannula	1-6 L/min	21-44
Venturi mask	4-12 L/min	24-50
Partial rebreather mask	6-10 L/min	35-60
Nonrebreather O_2 mask with reservoir	6-15 L/min	60-100
Bag-mask with nonrebreather "tail"	15 L/min	95-100

Note: Pulse oximetry provides a useful method of titrating oxygen administration to maintain physiologic oxygen saturation (see Precautions).

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Drug/Therapy	Indications/Precautions	Adult Dosage
Procainamide	**Indications** • Useful for treatment of a wide variety of arrhythmias, including stable monomorphic VT with normal QT interval and preserved LV function. • May use for treatment of PSVT uncontrolled by adenosine and vagal maneuvers if blood pressure stable. • Stable wide-complex tachycardia of unknown origin. • Atrial fibrillation with rapid rate in Wolff-Parkinson-White syndrome. **Precautions** • If cardiac or renal dysfunction is present, reduce maximum total dose to 12 mg/kg and maintenance infusion to 1 to 2 mg/min. • Proarrhythmic, especially in setting of AMI, hypokalemia, or hypomagnesemia. • May induce hypotension in patients with impaired LV function. • Use with caution with other drugs that prolong QT interval. Expert consultation advised.	**Recurrent VF/VT** • 20 mg/min IV infusion (maximum total dose: 17 mg/kg). • In urgent situations, up to 50 mg/min may be administered to total dose of 17 mg/kg. **Other Indications** • 20 mg/min IV infusion until one of the following occurs: — Arrhythmia suppression — Hypotension — QRS widens by >50% — Total dose of 17 mg/kg is given • Use in cardiac arrest limited by need for slow infusion and uncertain efficacy. **Maintenance Infusion** 1 to 4 mg/min (dilute in D_5W or NS). Reduce dose in presence of renal insufficiency.
Sodium Bicarbonate	**Indications** Specific indications for bicarbonate use are as follows: • Known preexisting hyperkalemia. • Known preexisting bicarbonate-responsive acidosis; eg, diabetic ketoacidosis, tricyclic antidepressant or aspirin overdose, cocaine, or diphenhydramine. • Prolonged resuscitation with effective ventilation; upon return of spontaneous circulation after long arrest interval. • Not useful or effective in hypercarbic acidosis (eg, cardiac arrest and CPR without intubation). **Precautions** • Adequate ventilation and CPR, not bicarbonate, are the major "buffer agents" in cardiac arrest. • Not recommended for routine use in cardiac arrest patients.	**IV Administration** • 1 mEq/kg IV bolus. • If rapidly available, use arterial blood gas analysis to guide bicarbonate therapy (calculated base deficits or bicarbonate concentration). ABG results not reliable indicators of acidosis during cardiac arrest.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Sotalol ***(IV form not approved for use in United States)*** Not a first-line antiarrhythmic Seek expert consultation	**Indications** In the United States, oral form is approved for treatment of ventricular and atrial arrhythmias. Outside the United States, used for treatment of supraventricular arrhythmias and ventricular arrhythmias in patients without structural heart disease. **Precautions/Contraindications** • Should be avoided in patients with poor perfusion because of significant negative inotropic effects. ***Must be infused slowly.*** • Adverse effects include bradycardia, hypotension, and arrhythmias (torsades de pointes). • Use with caution with other drugs that prolong QT interval (eg, procainamide, amiodarone).	**IV Administration** • 1 to 1.5 mg/kg body weight, then infused at rate of 10 mg/min. • ***Must be infused slowly.*** • Reduce dose with renal impairment.
Thrombolytic Agents *(see **Fibrinolytic Agents**)*		
Transcutaneous Pacing External pacemakers have either *fixed* rates (nondemand or asynchronous mode) or *demand* rates (range: 30 to 180 bpm). Current outputs range from 0 to 200 mA.	**Indications** • Hemodynamically unstable or symptomatic bradycardia (eg, blood pressure changes, altered mental status, angina, pulmonary edema). • Pacing readiness in setting of AMI, as follows: — Symptomatic sinus node dysfunction. — Type II second-degree heart block. — Third-degree heart block. — New left, right, or alternating BBB or bifascicular block. • Bradycardia with symptomatic ventricular escape rhythms. • Overdrive pacing of tachycardias refractory to drug therapy or electrical cardioversion. • Not recommended for bradyasystolic cardiac arrest. **Precautions** • Contraindicated in severe hypothermia or prolonged bradyasystolic cardiac arrest. • Conscious patients may require analgesia for discomfort. • Avoid using carotid pulse to confirm mechanical capture. Electrical stimulation causes muscular jerking that may mimic carotid pulse.	**Technique** • Place pacing electrodes on chest per package instructions. • Turn the pacer ON. • Set demand rate to approximately 80 bpm. • Set current (mA) output as follows for *bradycardia:* Increase milliamperes from minimum setting until consistent capture is achieved (characterized by a widening QRS and a broad T wave after each pacer spike). Then add 2 mA for safety margin.

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Drug/Therapy	Indications/Precautions	Adult Dosage
Vasopressin	**Indications** • May be used as an alternative pressor to epinephrine in the treatment of adult shock-refractory VF. • May be useful alternative to epinephrine in asystole, PEA. • May be useful for hemodynamic support in vasodilatory shock (eg, septic shock). **Precautions/Contraindications** • Potent peripheral vasoconstrictor. Increased peripheral vascular resistance may provoke cardiac ischemia and angina. • Not recommended for responsive patients with coronary artery disease.	**IV Administration** **One dose for cardiac arrest:** 40 U IV/IO push may replace either first or second dose of epinephrine. Epinephrine can be administerd every 3 to 5 minutes during cardiac arrest. Vasopressin may be given by the endotracheal route, but at this time there is insufficient evidence to recommend a specific dose.
Verapamil	**Indications** • Alternative drug (after adenosine) to terminate PSVT with narrow QRS complex and adequate blood pressure and *preserved LV function.* • May control ventricular response in patients with atrial fibrillation, flutter, or multifocal atrial tachycardia. **Precautions** • Give *only* to patients with narrow-complex PSVT or known supraventricular arrhythmias. • Do not use for wide-QRS tachycardias of uncertain origin, and avoid use for Wolff-Parkinson-White syndrome and atrial fibrillation, sick sinus syndrome, or second- or third-degree AV block without pacemaker. • May decrease myocardial contractility and can produce peripheral vasodilation and hypotension. IV calcium may restore blood pressure in toxic cases. • Concurrent IV administration with IV β-blockers may produce severe hypotension. Use with extreme caution in patients receiving oral β-blockers.	**IV Administration** • **First dose:** 2.5 to 5 mg IV bolus over 2 minutes (over 3 minutes in older patients). • **Second dose:** 5 to 10 mg, if needed, every 15 to 30 minutes. Maximum dose: 20 mg. • **Alternative:** 5 mg bolus every 15 minutes to total dose of 30 mg.

Sympathomimetic, Inotropic, and Inodilator Drugs

Drug	IV Infusion	Adrenergic Effect α	Adrenergic Effect β	Arrhythmogenic Potential
Epinephrine	2 to 10 µg/min	++	+++	+++
Norepinephrine	0.5 to 12 µg/min	+++	++	++
Dopamine	2 to 4 µg/kg per minute	+	+*	+
	5 to 10 µg/kg per minute	++	++*	++
	10 to 20 µg/kg per minute	+++	++	+++
Dobutamine	2 to 20 µg/kg per minute	+	+++	++
Isoproterenol	2 to 10 µg/min	0	+++	+++
Inamrinone† (formerly *amrinone*)	5 to 15 µg/kg per minute (after loading dose of 0.75 mg/kg not to exceed 1 mg/kg, given over 2 to 3 minutes or longer)	0	0*	++

*Increases renal and splanchnic blood flow. †Phosphodiesterase inhibitor.

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