

Current Cardiovascular Pharmacology

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This Presentation is Approved for
1 CRCE Credit Hour

Learning Objectives

- > Explain the actions, effects, indications, adverse effects, & precautions for agents from the following drug categories
 - ❖ Cardiotonic agents
 - ❖ Antidysrhythmic agents
 - ❖ Nitrates
 - ❖ Miscellaneous cardiovascular agents

Cardiotonic Agents

Epinephrine

- > Actions
 - ❖ Alpha1: vasoconstriction
 - ❖ Beta1
 - Chronotropic: heart rate
 - Inotropic: contractility
 - Dromotropic: conductivity
 - ❖ Beta2: smooth muscle relaxation
 - Bronchodilation
 - Vasodilation

Epinephrine

- > Effects
 - ❖ Increase systemic vascular resistance (SVR), blood pressure (BP), peripheral blood flow
 - ❖ Increase coronary & cerebral blood flow
 - ❖ Increase myocardial electrical activity → increased automaticity → increased HR
 - ❖ Increase myocardial contractility
 - ❖ Increase myocardial O₂ requirements

Epinephrine

- > Indications
 - ❖ Resuscitation
 - ❖ Shock, including anaphylaxis
 - ❖ Severe asthma

Epinephrine

- Routes
 - ❖ Intravenous (IV)
 - ❖ Subcutaneous (SC)
 - ❖ Endotracheal tube (ETT) - double IV dosage

Epinephrine

- Adverse effects
 - ❖ Hypertension
 - ❖ Myocardial infarction
 - ❖ Tachycardia
 - ❖ Peripheral tissue blood flow impairment (ischemia)

Norepinephrine (Levophed)

- Actions: alpha, beta1 adrenergic
- Effects
 - ❖ Increased SVR → increased BP
 - ❖ Increased HR
 - ❖ Positive inotropic

Norepinephrine (Levophed)

- Indication: neurogenic or septic shock
- Adverse effects
 - ❖ Myocardial hypoxia → infarction
 - ❖ Renal failure
 - ❖ Hypertension
 - ❖ Necrosis of exposed tissues
 - ❖ Peripheral ischemia

Dopamine

- Actions: alpha1, beta1 adrenergic, dopaminergic
- Effects (dose-dependent)
 - ❖ Low dose: Cerebral, renal, mesenteric vasodilation
 - ❖ Moderate dose: increase cardiac output
 - ❖ High dose: generalized vasoconstriction

Dopamine

- Indications
 - ❖ Hypotension (shock)
 - ❖ Decreased urinary output

Dopamine

- > Adverse effects
 - ❖ Tachycardia
 - ❖ Renal necrosis
 - ❖ Peripheral tissue necrosis
 - ❖ Dysrhythmias

Vasopressin (Pitressin)

- > Synthetic endogenous hormone: antidiuretic hormone
- > Effects
 - ❖ Anti-diuresis
 - ❖ Vasoconstriction
 - ❖ Stimulation of ACTH release

FYI see links below for information on vasopressin

Vasopressin (Pitressin)

- > Indications
 - ❖ Cardiac arrest
 - ❖ Shock
 - Septic
 - Hypovolemic
 - ❖ Diabetes insipidus: accompanies head trauma

Neosynephrine (Phenylephrine)

- > Action: alpha adrenergic
- > Effect: potent vasoconstrictor
- > Indications
 - ❖ Non-hypovolemic shock
 - ❖ Mucosal edema: post-extubation?
 - ❖ Mucosal bleeding
 - ❖ Prolong action of local anesthetics
- > Adverse effects: tissue ischemia

Dobutamine

- > Actions: alpha, beta1, beta2 adrenergic
- > Effects
 - ❖ Positive inotropic → increased cardiac output
 - ❖ Mild peripheral vasodilation → decreased PVR, SVR, increased coronary perfusion
 - ❖ Does NOT increase myocardial O₂
 - ❖ Combined with dopamine → maintain BP, without increasing PAP

Dobutamine

- > Indications
 - ❖ Acute congestive heart failure (CHF)
 - ❖ Right ventricular failure

Milrinone (Primacor)

- > Action: phosphodiesterase inhibitor
- > Effects
 - ❖ Inotropic
 - ❖ Vasodilation

Milrinone (Primacor)

- > Indications
 - ❖ Cardiomyopathy
 - ❖ Congestive heart failure
 - ❖ Pulmonary arterial hypertension (PAH)

Digitalis Glycoside: Digoxin

- > Action: increased Ca^{++} in myocardium
- > Effects
 - ❖ Positive inotropic
 - ❖ Negative dromotropic → depresses AV conduction

Digitalis Glycoside: Digoxin

- > Indication
 - ❖ Specific dysrhythmias
 - ❖ Chronic CHF

Digitalis Glycoside: Digoxin

- > Adverse effects: digitoxicity more likely with hypokalemia
 - ❖ Multiple types of dysrhythmias
 - ❖ Agitation
 - ❖ Nausea & vomiting

Antidysrhythmic Agents

Atropine

- > Action: parasympatholytic
- > Effects (cardiac)
 - ❖ Increased SA node automaticity → increased HR
 - ❖ Increased AV node conductivity

Atropine

- > Indications
 - ❖ Bradycardia
 - ❖ Heart block
 - ❖ Asystole: may be worth a try
- > Routes
 - ❖ IV
 - ❖ Instillation through ETT
- > Side effects: tachycardia

Lidocaine

- > Action: sodium channel blocker
- > Effects
 - ❖ Decreased automaticity
 - ❖ Decreased conductivity
 - ❖ Increased threshold for fibrillation
- > Indications: rapid ventricular dysrhythmias

Lidocaine

- > Routes
 - ❖ ETT administration → double dose
 - ❖ IV
- > Adverse effects
 - ❖ Psychoses, seizures
 - ❖ Decreased contractility
 - ❖ Heart block: asystole
 - ❖ Increased threshold for defibrillation
 - ❖ Lethal if given for heart block with escape beats

Amiodarone (Cordarone)

- > Action: multiple ion channel blocker
- > Effects
 - ❖ Decreased AV conduction
 - ❖ Decreased sinus node function
- > Indications: dysrhythmias
- > Adverse effects (circulatory)
 - ❖ Hypotension
 - ❖ Bradycardia

Amiodarone (Cordarone)

- > Adverse effects (pulmonary): occurs over days-years of treatment
 - ❖ Pulmonary oxygen toxicity
 - ❖ Interstitial pneumonitis
 - ❖ Pulmonary infiltrates
 - ❖ Organizing pneumonia ± bronchiolitis obliterans (BOOP)
 - ❖ Pulmonary fibrosis

FYI see links below for article on amiodarone toxicity

Amiodarone (Cordarone)

- > Adverse effects (pulmonary)
 - ❖ A-C membrane permeability edema with or without ARDS
 - ❖ Alveolar hemorrhage
 - ❖ Bronchospasm
 - ❖ Laryngeal edema
 - ❖ Anaphylactic shock
 - ❖ Pleural effusion
 - ❖ Pleural / pericardial thickening

Dronedronone (Multaq)

- > Indication - atrial fibrillation / flutter
 - > Contraindications
 - ❖ Severe heart failure
 - ❖ Liver disease
 - > Less effective than amiodarone
 - > Fewer adverse effects
 - > Hepatotoxic
 - > More expensive than amiodarone, but reduces hospitalization for AF
- FYI see links below for article on dronedronone

Beta Adrenergic Blockers

- > Action: beta1 blockade
- > Effects
 - ❖ Decreased HR
 - ❖ Decreased vascular resistance
 - ❖ Decreased contractility
 - ❖ Decreased conductivity
 - ❖ Decreased myocardial O₂ consumption

Beta Adrenergic Blockers

- > Indications
 - ❖ Angina
 - ❖ Hypertension
 - ❖ Post-MI
 - ❖ Inhibit ventricular response to atrial flutter, fibrillation

Beta Adrenergic Blockers

- > Side effects
 - ❖ Hypotension
 - ❖ CHF
 - ❖ Bronchospasm: non-selective agents

Beta Adrenergic Blockers

- > Agents
 - ❖ Propranolol (non-selective)
 - ❖ Atenolol
 - ❖ Metoprolol
 - ❖ Sotalol (Betapace): non-selective
 - ❖ Esmolol: short duration of action
 - ❖ Nadolol (Corgard): non-selective
 - ❖ Sotalol (Betapace)

Calcium Channel Blockers

- > Action: block entry of Ca^{++} to myocardium
- > Indications
 - ❖ Angina
 - ❖ Dysrhythmias, e.g. PSVT
 - ❖ Hypertension

Calcium Channel Blockers

- > Agents
 - ❖ Verapamil (Calan, Isoptan)
 - ❖ Diltiazem (Cardizem)
 - ❖ Amlodipine (Norvasc)

Magnesium Sulfate

- > Action: replacement for depletion of Mg^{++}
 - ❖ Malnourishment
 - ❖ Alcoholism
- > Effects
 - ❖ Reverses torsades des pointes
 - ❖ Relaxes bronchial smooth muscle
 - ❖ Relaxes uterine muscle

Magnesium Sulfate

- > Indications
 - ❖ Hypomagnesemia
 - ❖ Torsades des points VT
 - ❖ Status asthmaticus
 - ❖ Pre-eclampsia / eclampsia
- > Adverse effects: minimal

Nitrates

Sodium Nitroprusside (Nipride)

- > Effects: vasodilation, arterial & venous
- > Indications
 - ❖ Hypertensive emergency
 - ❖ LV failure

Sodium Nitroprusside (Nipride)

- Adverse effects
 - ❖ Cyanide poisoning
 - ❖ Hypotension
- Precaution: avoid exposure of agent to light

Nitroglycerine

- Effect: decreased SVR → decreased afterload & preload
- Side effects: hypotension, headache
- Indication: angina pectoris, AMI
- Preparations: sublingual tablets, IV, patches

Miscellaneous Agents

Nesiritide (Natrecor)

- Synthetic recombinant brain natriuretic peptide (BNP)
 - ❖ Potent vasodilator
 - ❖ Rapid reduction in PCWP
- FDA approval in 2001
- Indication
 - ❖ Severe decompensated CHF
 - ❖ Dyspnea at rest or minimal activity

FYI see links below for article on nesiritide

Nesiritide (Natrecor)

- Contraindications
 - ❖ Low filling pressures
 - ❖ Hypotension
- Adverse effects
 - ❖ Kidney failure
 - ❖ Death
 - ❖ Litigation

Angiotensin Converting Enzyme (ACE) Inhibitors

- Action: block conversion of angiotensin I to angiotensin II
- Effect: vasodilation
- Indications
 - ❖ Hypertension
 - ❖ Heart failure
- Side effect: chronic, dry cough

Angiotensin Converting Enzyme (ACE) Inhibitors

- > Side effects
 - ❖ Chronic, dry cough
 - ❖ Angioedema: airway obstruction

FYI see links below for info on ACE inhibitors

ACE Inhibitors

- > Agents
 - ❖ Lisinopril (Zestril, Prinivil)
 - ❖ Ramipril (Altace)
 - ❖ Enalapril (Vasotec)
 - ❖ Benazepril (Lotensin)
 - ❖ Captopril (Capoten)

Summary & Review

- > Cardiotonic agents: stimulatory cardiovascular effects
 - ❖ Epinephrine
 - ❖ Norepinephrine
 - ❖ Dopamine
 - ❖ Dobutamine
 - ❖ Milrinone
 - ❖ Vasopressin
 - ❖ Digitalis

Summary & Review

- > Antidysrhythmic agents
 - ❖ Atropine
 - ❖ Lidocaine
 - ❖ Amiodarone
 - ❖ Beta adrenergic blockers
 - ❖ Calcium channel blockers
 - ❖ Magnesium sulfate

Summary & Review

- > Nitrates: vasodilators
 - ❖ Sodium nitroprusside
 - ❖ Nitroglycerine
- > Miscellaneous agents
 - ❖ Nesiritide: vasodilator for severe CHF
 - ❖ ACE inhibitors: antihypertensive