

Pharmacology - study of drugs and their interaction with living systems

Drug - any chemical that affects living tissues

Pharmacokinetics - The study of how drugs enter the body, reach their sites of action and are eliminated from the body. Absorption, excretion, metabolism, excretion

Agonist - Drugs that bind to specific receptors and elicit a physiological response

Antagonist - A Drug which either competes with or blocks an agonist receptor site

### CONTROLLED SUBSTANCES AND SEDATIVES

#### Midazolam

- Class - Short Acting benzodiazepine, sedative, hypnotic, antianxiety
  - Schedule IV Controlled Substance
- Action - depresses subcortical levels in CNS
- Clinical Uses - procedural sedation, med facilitated intubation, seizures, conscious sedation
- Protocols
  - Med Facilitated Intubation 1-5mg IV/IO/IN MCO
  - Procedural sedation 1-5mg IV/IO/IN MCO
  - ROSC 1-5mg IV/IO (for shivering) MCO
  - Seizures / Stat Ep 1-5mg IV/IO/IM/IN Standing orders - repeat MCO
  - EDP 1-5mg IV/IO/IM/IN MCO
  - Poisoning, OD Cocaine, Amphetamine, ETOC Sympathomimetic withdrawal 1-2mg IV/IO/IM MCO
  - Peds Stat Ep - 0.2mg/kg IM/IN (max 5mg) IN preferred std order medic if stat ep and good BG
- Side Effects - Amnesia, Hypotension, Respiratory Depression, Broncho or laryngo spasm, nausea vomiting
- Contraindications - shock, use with other CNS depressants, glaucoma
- Pharmacokinetics - Onset: IV/IN 1-3 min; IM 15-30 min
  - Peak effect variable
  - Half life - 2-6 hours

#### Haldol

- Class - Typical antipsychotic, dopamine receptor antagonist
- Action - blocks the effects of dopamine in the CNS, mild anticholinergic effects, decrease the signs and symptoms of psychoses
- Protocols
  - Behavioral emergencies - 2-5mg IM MCO
- Side effects - sedation, decreased LOC, resp depression, hypotension, tachycardia, dry mouth, constipation, extrapyramidal dystonic reactions

- Contraindications - hypersensitivity, CNS depression, circulatory compromise
- Precautions - May lower seizure threshold in patients with seizure history, may exacerbate effects of antihypertensive and vasodilator medications, PUSH SLOWLY, monitor lengthening QT interval, V-Tach, Torsades
- Pharmacokinetics - Onset - within minutes, Peak effect - 20 min IM, Duration 2-6 hours, half-life 21 days

## Diazepam / Valium

- Class - benzodiazepine
  - Schedule IV Controlled Substance
- Action - decrease muscle activity, emotional response, and level of consciousness
  - Acts on subcortical levels with the brain and limbic system, blocks spinal cord neuronal transmission, relaxing skeletal muscle, causes CNS depression
- Clinical Uses - Sedation prior to cardioversion / pacing, mgmt. of grand mal status ep, eclampsia, sedation in acute behavioral emergencies, medication facilitated intubation
- Protocols
  - Med facilitated intubation - 5-10mg IV/IO w/ repeat to max 20mg MCO
    - After intubation 5mg IV/IO for continued sedation MCO
  - Procedural Sedation 5-10mg IV/IO MCO
  - ROSC - 5mg IV MCO
  - Seizures / Stat Ep - 5mg w/ repeat 5mg IV/IO/IM/PR Standing order and MCO
  - EDP 2-10 mg IV/IO/IM MCO
  - Poisoning / OD - OD of Cocain, Amphetamine, Sympathomimetics, ETOC Withdrawal 2-10mg IV/IO MCO
  - Organophosphate, Nerve Agent Exposure - 2-10mg IV/IO/IN/PR Max ttl dose 20mg MCO
  - Eclampsia - 5mg IV/IM Refractory seizures MCO
  - Peds Stat Ep - 0.1mg/kg IV/IO slowly over 2 min MCO repeat is seizures persist
    - If no IV/IO 0.1mg/kg PR (per rectum) MCO
- NO VALIUM IF SEIZURES STOPPED
- Contraindications - Hypersensitivity/allergy, Pre existing CNS depression, Shock/hypotension
- Pharmacokinetics
  - Onset IV 1-5min - duration 15-60min
  - Onset IM 15-30min - longer duration

## Lorazepam - Ativan

- Class - benzodiazepine, anticonvulsant, sedative, hypnotic
- Action - binds to gamma-aminobutyric acid (GABA) A sites within the brain
  - GABA is a main inhibitory neurotransmitter of the CNS
- Clinical Uses - major motor seizures, stat ep, procedural sedation, acute agitation / anxiety
- Contraindications - hypersensitivity/allergy, caution with prior CNS depression
- Protocols

- o Medication facilitated intubation - 2-4mg IV/IO/IN repeat PRN (max 4mg) MCO
- o Procedural sedation - 2-4mg IN/IO/IN MCO
- o Seizures / Stat Ep - 2-4mg IV/IO/IM both standing and MCO
- o Behavioral emergencies / agitation - 1-2mg IV/IO/IM/IN MCO
- o Poisoning / OD Tox - Cocaine, Amphetamines, sympathomimetics, ETOH withdrawal 1-2mg IV/IO/IM MCO
- o Peds Stat Ep - 0.05mg/kg IV/IN/IO (slowly over 2 minutes) repeat if seizures persist
- Side Effects - hypotension, CNS depression, Resp Depression, Nausea and Vomiting
- Contraindications
- Pharmacokinetics - Onset IV 1-5 min, IM 15-30 min
  - o Peak effects - IV 15-20 min, IM 2 Hours
  - o Duration - 6-8 hours
  - o Half Life - 10-20 hours

#### Fentanyl Citrate (Sublimaze)

- Class - Narcotic analgesic / opioid
  - o Schedule II Controlled substance
- Action - 50-100 times more potent than morphine, shorter duration of action than other narcotic analgesics, used primarily for analgesia and sedation
- Protocols
  - o Pain Mgmt, Procedural Sedation, ACS/Chest Pain 1mcg/kg IV/IO/IM/IN (max 100mcg) MCO
  - o ROSC - 1mcg/kg IV/IO (max 100mcg)
- Side Effects - resp depression, apnea, muscle rigidity, bradycardia, enhanced effect w/ CNS depressants, Potentiation by MAOI (avoid use within 14 days of taking MAOI)
- Contraindications - shock, hypersensitivity, severe hemorrhage
- Precautions - may cause bradycardia, liver and renal patients may have decreased ability to metabolize and excrete drug, monitor vital signs frequently
- Pharmacokinetics - Onset - immediate, peak effects - 3-5min, duration - 30-60min, half life 6-8hrs

#### Morphine

- Class - Narcotic Analgesic, Opioid
  - o Schedule II Controlled substance
- Action - Powerful CNS depressant, relieves pain, decreases systemic vascular resistance / venous return, produces vasodilatory effects
- Clinical Uses - pain management associated with burns, isolated extremity fractures/dislocations/ long transport times or disentanglements, ACS/Chest Pain
- Protocols

- o Pain Management (non-Cardiac) 2-10mg (0.1mg/kg) IV/IM (max 20mg ttl)
  - Standing orders for medic MCO for both
- o Procedural Sedation or ACS/chest pain 2-10 (0.1mg/kg) IV/IO MCO
- Side Effects - Hypotension, respiratory depression, dizziness, altered LOC, additive CNS depression when used with similar drugs, nausea/vomiting
- Contraindications - Hypersensitivity, shock/hypotension, resp depression, head injury

#### Etomidate

- Class - Short Acting sedative / hypnotic
- Action - rapid induction of anesthesia with minimal respiratory and cardiovascular effects, useful in RSI for hypotensive patients, produces no histamine release, yields no analgesic effects.
- Protocols
  - o Med facilitated intubation - 0.3mg/kg RAPID IV/IO push (max dose 20mg) MCO
  - o Procedural Sedation - 0.15mg/kg IV/IO (max dose 10mg) MCO
- Precautions - significant hypotension, severe asthma patients, severe cardiovascular disease, arrhythmias, caution in use with elderly.
- Side effects - apnea, laryngospasm, myoclonic skeletal muscle movement, nausea/vomiting, use with verapamil may cause resp depression or apnea, arrhythmias
- Pharmacokinetics - Onset 10-20 sec. Peak effects <1 min, Duration 3-5 min, Half Life 30-70 min

## Questions

Clinical uses of benzodiazepine include all of the following except - Management of acute chest pain.

Side effects of benzodiazepines include all of the following except - Hypertension

The best choice for very short term sedation for cardioversion due to its short half life and duration would be - Midazolam

Valium is often used as a substitute for morphine because - it is 50-100 times more potent than morphine

Side effects for fentanyl include all of the following except - tachycardia

Typical dosages for fentanyl would be - 1mcg/kg slowly over one minute

Morphine sulfate is under what class of controlled substances - Schedule II

Morphine sulfate should be administered to - a 32M in 10/10 pain w/ amputated left foot

Side effects of morphine sulfate admin include all of the following effect - hypertension

Actions of ms include all of the following except - vasoconstrictive effects

Etomidate belongs to which class of medications - short acting sedative/hypnotic

All are actions of etomidate except - produce histamine release

Side effects of etomidate include all of the following except - hypertension

Etomidate should be used cautiously when being administered to severe asthma patients.

Haldol belongs to which medication class - antipsychotic - dopamine receptor antagonist

Common side effects of Haldol include all of the following except - bradycardia

Haldol should be given with caution to some patients because it - all of the above

## Cardiac Regulatory Centers - Medulla Oblongata

- Cardio-acceleratory center - SYMPATHETIC
  - Norepinephrine neurotransmitter
  - innervation at cardiac plexus
  - dominant with stress
- Cardio-inhibitory center - PARASYMPATHETIC
  - Acetylcholine neurotransmitter
  - Innervation by vagus nerve
  - Dominant at rest

## Vasomotor regulation center

- Baroreceptors (aortic and carotid sinuses, RA)
- Chemoreceptors (aortic and carotid bodies)

## Chronotropy - Rate

Inotropy (contractile force)

Dromotropy (speed of conduction)

Alpha1 - peripheral effects - vasoconstriction

Beta1 - Cardiac effects - vasoconstriction, +chronotropy, +inotropy, +dromotropy

Beta2 - Pulmonary effects - bronchodilation, vasodilation

## Amiodarone

- Class - Class 3 antiarrhythmic - cardiac ion channel blocker
- Action - blocks potassium, sodium and calcium channels along with adrenergic B-receptors; prolongs cardiac repolarization; increases refractory periods; slows heart rate; increases QT and PR intervals
- Protocol
  - Cardiac Arrest VF/Pulseless VT - 300mg IV/IO (diluted in 20-30 ml D5W)
    - Repeat MCO 150mg IV/IO (diluted in 10ml D5W)
  - Wide complex Tachycardia w/ pulse - 150mg IV/IO in 10ml D5W IV/IO over 10 minutes medic standing order other MCO
  - Narrow complex tachycardia - MCO only 150mg IV/IO over 10 min (diluted in 100ml D5W)
  - Peds non-trauma cardiac arrest - MCO only 5mg/kg IV/IO if VF/VT (max 300mg)
- Side effects - Hypotension, Bradycardia, Potentiates effects of coumadin, may worsen digitalis toxicity

- Contraindications - Bradycardia, AV Blocks, Pregnancy (relative), Caution in patients with decreased lung function, may cause pulmonary fibrosis
- Pharmacokinetics - Half life - 58 Days, Onset within minutes



## Diltiazem / Cardizem

- Class - Calcium Channel Blocker, Class IV antiarrhythmic
- Action - Inhibits calcium movement across cardiac and smooth muscle membranes causing dilation of coronary arteries, peripheral arteries and arterioles; prolongs the conduction of electrical impulses through the AV node.
- Protocol
  - Narrow complex tachycardia - 0.25mg/kg SLOW IV (over 2 minutes) MCO
    - For Rapid A-Fib and Rapid A-Flutter
- Side effects - Flushing, headache, bradycardia, hypotension, heart block, myocardial depression, Severe AV block, in high doses - cardiac arrest
- Contraindications - Acute MI; CHF; Hypersensitivity to diltiazem or other calcium channel blockers; second/third degree AV blocks (unless in the presence of a pacemaker); severe hypotension (<90mmHg); sick sinus syndrome
- Precautions - renal/hepatic impairment; patients taking beta blocking medications - may potentiate effects of both medications.
- Pharmacokinetics - Onset - 3 minutes, Peak effect - N/A, Duration - N/A, Half -Life 3-8 hours.

## Magnesium Sulfate

- Class - Electrolyte, tocolytic, mineral
- Action - required for normal physiologic functioning; is a cofactor in neurochemical transmission and muscular excitability; controls seizures by blocking peripheral neuromuscular transmission; also acts as a peripheral vasodilator and inhibitor of platelet function.
- Protocol -
  - Asthma / Bronchospasm - MCO only 2Gm IV/IO (In 100ml NaCl) over 10-20 min
  - Cardiac Arrest VF/Pulseless VT - 1-2Gm IV/IO MCO Only
  - Wide Complex Tachycardia - 1-2Gm IV/IO in 100ml NaCl over 10 min MCO only
  - Seizures / Stat Ep - MCO only 2Gm IV/IO (in 100cc NaCl) over 10 min if eclampsia
  - OB / Pregnancy related - MCO only 2Gm IV/IO (in 100ml NaCl) over 10 min for seizures (may repeat)
  - Peds Non trauma arrest - MCO only 25-50mg/kg (max 2Gm) IV/IO for torsades de pointes
- Side effects - magnesium toxicity (signs include flushing of the skin, diaphoresis, hypotension, muscle paralysis, weakness, hypothermia, and cardiac, CNS or respiratory depression; prolonged PR interval, widening of QRS)
- Contraindications - AV Block, GI obstruction
- Precautions - renal insufficiency
- Pharmacokinetics - onset - immediate, peak effect - unknown, duration - 30-60 min, half life - NA

## Norepinephrine / Levophed

- Class - sympathomimetic vasopressor
- Action - stimulates beta1 and alpha adrenergic receptors; increases peripheral resistance through vasoconstriction; enhances contractile myocardial force; increases cardiac output
- Protocol
  - Hypoperfusion/shock; acute pulmonary edema/anaphylaxis/ROSC
    - MCO ONLY 2-4 mcg/min IV/IO initial dose (max dose 30 mcg/min)
    - Use Large Vein / IV pump HIGHLY recommended
- Side effects - Anxiety, tremors, headache, dizziness, nausea, vomiting, reflex bradycardia, palpitations, increased myocardial oxygen demand - angina pain, dyspnea
- Contraindications - hypovolemic states; mesenteric/peripheral vascular thrombus; profound hypoxia
- Precautions - severe cardiac disease; hypothyroidism; patients taking MAOIs
- Pharmacokinetics - Onset - rapid, peak effect - 1-2 minutes, duration NA, Half Life short 1-2 min

## Racemic Epinephrine / Micronefrin / S2 Vapoefrin

- Class - Bronchodilator; adrenergic agent; equivalent to 1:100 epinephrine
- Action - stimulates both alpha and beta receptors, causing vasoconstriction, reduced mucosal edema and bronchodilation.
- Protocol
  - Peds Resp Distress - MCO Only 0.05mg/kg in 3ml NS (max 5ml) via nebulizer for suspected croup / epiglottitis
- Side effects - increased heart rate, nausea, anxiety, heart palpitation and headache.
- Contraindications - epiglottitis, known sensitivity to sulfites
- Precautions - tachycardia and arrhythmias
- Pharmacokinetics - Onset - 3-5 min, peak effect - 20 min, duration 1-3 hours, half life - 2min

## Questions

The receptors responsible for increasing heart rate and automaticity are - beta receptors

Amiodarone is a class 3 antiarrhythmic. Its action blocks - all of the above

Side effects of amiodarone may include all - hypotension

Diltiazem prolongs the conduction of electrical impulses through the - AV node

Contraindications for diltiazem administration include all of the following except - Tachycardia

Magnesium Sulfate is clinically used to treat the following conditions except - cardiac chest pain

A sign of magnesium toxicity would be - hypotension

Norepinephrine (levophed) is listed as what drug class - sympathomimetic

A precaution for norepinephrine (levophed) administration is - severe cardiac disease

Racemic Epinephrine - Stimulates both alpha and beta receptors causing vasoconstriction, reduced mucosal edema and bronchodilation.

Side effects of the use of racemic epinephrine include - tachycardia

## Adrenal Insufficiency

- Causes - Congenital adrenal insufficiency (CAH); Infection; injury; auto-immune reaction of the adrenal gland secondary to TB, trauma or Addison's disease
- Signs and Symptoms - Hypoglycemia, dehydration, weight loss, AMS, weakness/lethargy, dizziness, hypotension, muscle aches, nausea / vomiting.

## Hydrocortisone (Solu-Cortef)

- Class - adrenal corticosteroid
- Action - inhibits accumulation of inflammatory cells at inflammation sites; as a steroid, it replaces the steroids that are lacking in adrenal insufficiency
- Protocol
  - Hypoperfusion / shock - 2mg/kg IV/IO (max dose 100mg)
  - Adrenal insufficiency MUST be confirmed by patient record, family or medical alert tag
- Side effects - insomnia; heartburn; anxiety; abdominal distention; diaphoresis; acne; mood swings; increased appetite; facial flushing; delayed wound healing; increased susceptibility to sepsis, diarrhea or constipation; leukocytosis; hyperglycemia

## Dexamethasone (Decadron)

- Class - corticosteroid
- Action - reduces inflammation and immune responses by inhibiting the synthesis of pro-inflammatory enzymes; intermediate to long acting steroid
- Protocol
  - Asthma / Bronchospasm, COPD - 12mg IV/IO/IM Medic standing order MCO for both
  - Anaphylaxis - 12mg IV/IO/IM standing order and MCO for both
  - Peds resp distress - MCO only 0.6mg/kg IV/IO
- Side effects - nausea/vomiting, water retention - edema, hypertension, hyperglycemia, immunosuppression
- Contraindications - fungal infections, hypersensitivity
- Precautions - respiratory TB; Untreated systemic infections; hyperthyroidism; cirrhosis; ulcerative colitis; hypertension; CHF; seizure disorder; peptic ulcer disease; diabetes
- Pharmacokinetics - Onset - 1hr; peak effect - 1hr; duration - variable; half life - 3-4.5hrs

## Methylprednisolone (Solumedrol)

- Class - Adrenal Corticosteroid
- Action - reduces inflammation by multiple mechanisms; inhibits the synthesis of pro-inflammatory enzymes; intermediate acting steroid.
- Protocol

- o Asthma / Bronchospasm - 125mg IV/IO/IM - Standing order medic; MCO for both
- o COPD - 125mg IV/IO - Standing order for medic; MCO for both
- o Anaphylaxis - 125mg IV/IO - Standing orders and MCO for both
- o Peds resp distress & Peds anaphylactic reaction- MCO only 2mg/kg IV/IO (max dose 60mg)
- Side effects - depression; euphoria; headache; restlessness; hypertension; bradycardia; nausea/ vomiting; swelling; diarrhea; weakness; fluid retention (edema); parasthesias
- Contraindications - cushings syndrome; fungal infection; measles; varicella; known sensitivity (including sulfites)
- Precautions - active infections; renal disease; penetrating spinal cord injury; hypertension; seizures; CHF
- Pharmacokinetics - Onset - immediate; peak effect - 30min; duration 8-24hrs; half life 3-3.5hrs

#### Ondansetron (Zofran)

- Class - Selective receptor (serotonin type 3) antagonist; antinausea; antiemetic
- Action - blocks serotonin, both peripherally on vagal nerve terminals and centrally in the chemoreceptor trigger zone.
- Protocol
  - o Procedural Sedation - 4mg IV/IO may be repeated MCO Only
  - o Severe Nausea / vomiting - 4mg IV/IO over 2 min (may be repeated) medic standing order MCO both
- Side effects - Headache; dizziness; malaise; drowsiness; fatigue; weakness; extrapyramidal reactions; chest pain; hypotension constipation; diarrhea; abdominal pain; dry mouth; urinary retention; bronchospasm; rash; shivering; anaphylaxis
- Contraindications - hypersensitivity
- Precautions - hepatic disease, not recommended for children under 12 years of age.
- Pharmacokinetics - Onset - immediate; peak effect 15-30min; duration 4-8hrs; half life 4hrs.

#### Tetracaine (Pontocaine)

- Class - topical anesthetic - ocular
- Action - tetracaine blocks both the initiation and conduction of nerve impulses by decreasing the neuronal membranes permeability to sodium ions. This reversibly stabilizes the membrane and inhibits depolarization, resulting in the failure of a propagated action potential and subsequent conduction blockade.
- Protocol
  - o Poisoning / OD / toxic exposure - MCO only eye injury 2 gtts in the effected eye(s) before irrigation
- Side effects - minor initial burning, redness and irritation.
- Pharmacokinetics - onset - immediate; peak effect - NA; Duration - 15-30min; Half Life 30-60sec

## Questions

Patients with adrenal insufficiency have signs & Symptoms which include - hypotension

The correct medication for the treatment of adrenal insufficiency is - solucortef

One side effect of dexamethasone is - hyperglycemia

All are precautions for the administration of dexamethasone except - hypotension

Clinical uses for methylprednisolone include - All of the above

One side effect of solumedrol administration is - fluid retention

Ondestetron (Zofran) falls into what drug class - Selective serotonin type 3 antagonist

Which patient should ondansetron (zofran) NOT be administered to - 8M with acute appendicitis

Tetracaine is used clinically for - acute eye pain from injury or chemical reaction

Tetracaine is contraindicated for - known hypersensitivity