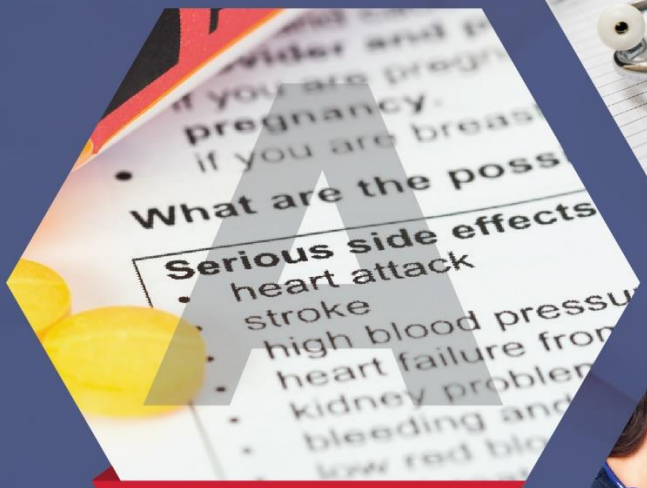
PHARMACOLOGY NOTES

NURSING IMPLICATIONS FOR CLINICAL PRACTICE

Administration

Therapeutic Effects



Adverse Effects

Teaching

GLORIA VELARDE

PHARMACOLOGY NOTES

NURSING IMPLICATIONS FOR CLINICAL PRACTICE

Overview

There are currently nine (9) units comprising this *Pharmacology Notes* resource. Units are broken down by body system and published individually for ease of retrieval:

Unit A: Autonomic Nervous System (ANS) Pharmacology

Unit B: Cardiovascular (CV) System Pharmacology

Unit C: Hematological System Pharmacology

Unit D: Central Nervous System (CNS) Pharmacology

Unit E: Skeletal System: Bone and Joint Pharmacology

Unit F: Immune System Pharmacology

Unit G: Digestive System Pharmacology

Unit H: Endocrine System Pharmacology

Unit I: Respiratory System Pharmacology

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UNIT D

CENTRAL NERVOUS SYSTEM PHARMACOLOGY

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(SC) Benzodiazepines
(SC) Hydantoins
(SC) Succinimides
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(SC) Dopaminergics
(SC) Anticholinergics

(MC) Anti-Alzheimer's Agents
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(SC) Antimigraine Agents

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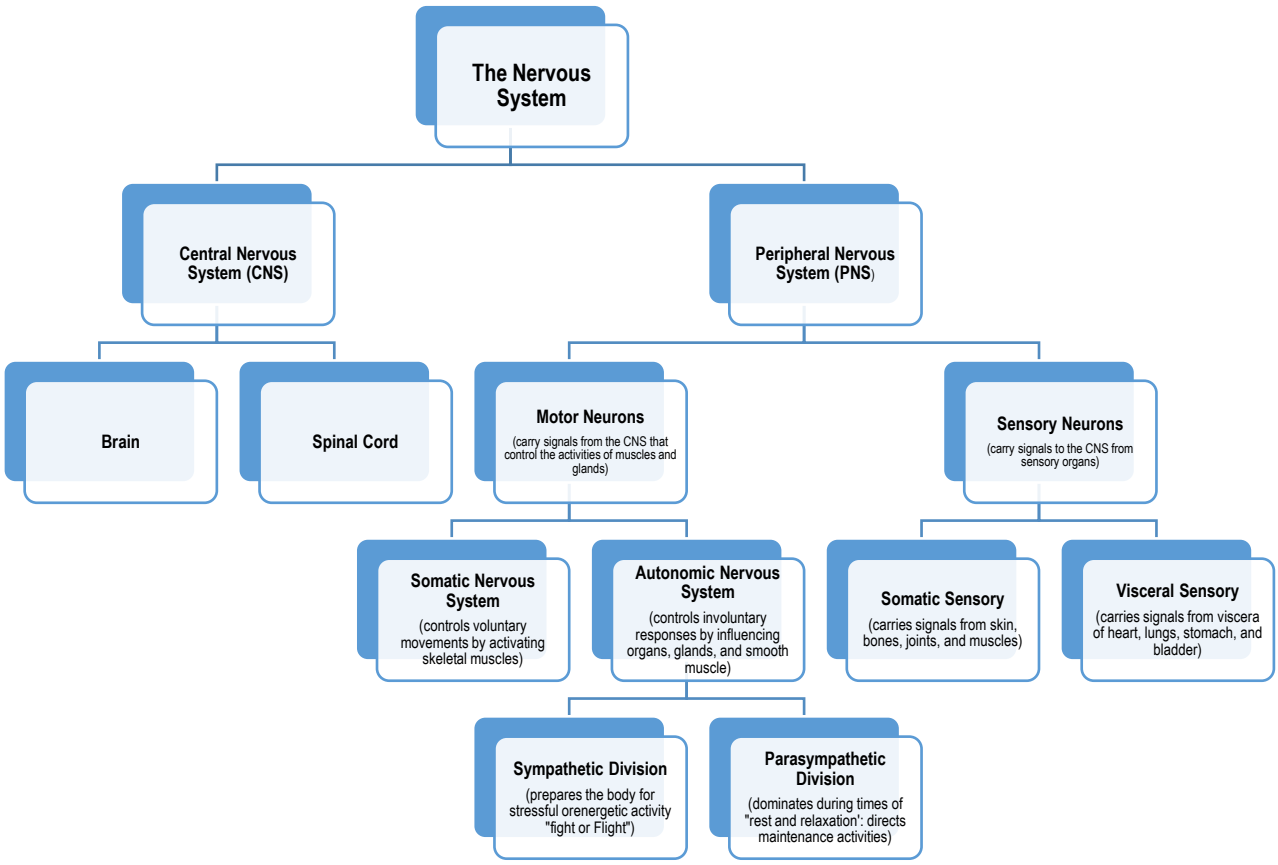
(SC) Narcotic Addiction Agents
(SC) Nicotine/Smoking Cessation

Central Nervous System (CNS) Pharmacology

I. Anatomy and Physiology/Pathophysiology Review

A. The Nervous System



B. General Divisions, Structures, and Functions of the CNS

1. Hindbrain consists of the medulla oblongata, the pons (part of the brain stem), and the cerebellum, which control respiration and other basic bodily processes and movement among other functions
2. Midbrain is interposed between the hindbrain and the forebrain (part of the brain stem):
   a. Ventral areas – control motor function
   b. Dorsal regions – involved in sensory information circuits
   c. Reticular activating system – maintains a state of wakefulness and alertness
3. Forebrain (interbrain) consists of:
   a. Diencephalon:
      1) thalamus – processes and filters sensory impulses to cerebral cortex
      2) hypothalamus – controls ANS; coordinates endocrine system; contains hunger, thirst, and temperature regulatory centers; affects emotional responses

3) thalamus and hypothalamus are part of the limbic system – regulates emotions and motivated behaviors like sexuality and hunger. Additional structures that are part of the limbic system:
    a) hippocampus – converts short-term memory into long-term memory
    b) amygdala – relates to emotions, both current and those stored from previous experiences
    c) basal ganglia – organizes motor behavior; coordinates rule-based, habit learning
    d) cingulate gyrus – coordinates smells and sights with pleasant memories, induces an emotional reaction to pain and helps regulate aggressive behavior

b. Telencephalon – contains the cerebrum (outer layer of gray matter – cerebral cortex), which is the highest level of cognitive processing such as consciousness, thought, reason, emotion, and memory

4. Spinal cord – tail-like structure embedded in the vertebral canal of the spine; involved in transporting sensorimotor information and controlling nearby organs

C. Communication within the CNS

1. Neurons – sensory (afferent), interneurons, and motor (efferent) neurons
2. Synapse – the area that nerve impulses are transferred from one neuron to another:
    a. electrically
    b. chemically = neurotransmitters

D. Major Neurotransmitters (NTs) and their Functions

1. Types:
    a. Excitatory (↑ chance of firing):
        1) acetylcholine (CNS)
        2) norepinephrine
        3) aspartate
        4) glutamate
    b. Inhibitory (↓ chance of firing):
        1) acetylcholine (PNS)
        2) dopamine
        3) gamma-aminobutyric acid (GABA)
        4) serotonin
2. Functions:
    a. Norepinephrine (associated with "fight or flight" response):
        1) Lower levels:
            a) loss of alertness, arousal and interest
            b) associated with:
                (1) depression
                (2) ADHD

2) High levels:
    a) CNS stimulant
    b) associated with:
        (1) anxiety disorders
        (2) panic attacks
        (3) addiction

b. Dopamine:
    1) strongly influences both motor and thinking areas of the brain
    2) linked to:
        a) motor/movement disorders (Parkinson's)
        b) ADHD
        c) addiction
        d) paranoia and schizophrenia

c. Serotonin:
    1) major regulator involved in bodily processes:
        a) sleep
        b) libido (sexual interest)
        c) mood
        d) body temperature
        e) and other areas
    2) implicated in multiple psychiatric disorders:
        a) depression & bipolar disorders
        b) obsessive-compulsive disorder
        c) anorexia nervosa, bulimia nervosa
        d) body dysmorphic disorder
        e) social anxiety, phobias

d. GABA:
    1) inhibitory neurotransmitter (decreases the ability of other neurotransmitters to work)
    2) regulates communication of brain neurotransmitters
    3) low levels: associated with:
        a) bipolar disorder: mania
        b) anxiety disorders
        c) impulse control problems
        d) seizure disorders
    4) high levels: associated with:
        a) being overly relaxed and sedated
        b) normal reactions are impaired

e. Glutamate
    1) excitatory neurotransmitter
    2) works together with GABA to control many other brain function including the brain's level of excitation
    3) regulates action potential of cells

E. Common Neurological Disorders

1. Seizures/Epilepsy
    a. Description: a disturbance of electrical activity in the brain affecting consciousness, motor activity, and sensation; linked to ↑ excitatory NT and/or ↓ inhibitory NT
    b. Causes:
        1) infectious diseases → febrile status
        2) head trauma
        3) metabolic disorders
        4) vascular diseases
        5) neoplastic diseases
        6) other drugs – overdose or toxicity
    c. Classification of seizure types:
        1) generalized onset – travel throughout the brain:
            a) motor: tonic-clonic or convulsive (formerly known as grand mal)
            b) non-motor: absence (formally known as petit-mal)
        2) focal onset (formally known as partial) – starts in one area or group of cells in one side of the brain
        3) unknown onset – not witnessed or seen by anyone
    d. Key s/sx:
        1) motor: jerking (clonic), muscles becoming limp or weak (atonic), tense or rigid muscles (tonic), brief muscle twitching (myoclonus), or epileptic spasms
        2) non-motor: changes in sensation, emotions, thinking or cognition, autonomic functions (i.e. GI sensations, waves of heat or cold, goosebumps, heart racing, etc.), or lack of movement (behavior arrest)
2. Parkinson's Disease
    a. Description: chronic progressive, degenerative CNS disorder → neurotransmitter imbalance by death of neurons in region of brain controlling involuntary muscle movements:
        1) ↑ Ach
        2) ↓ dopamine
    b. Cause: unclear; linked to genetic and autoimmune factors
    c. Key s/sx (parkinsonism or extrapyramidal symptoms:
        1) Shuffling gait
        2) Mask-like faces
        3) A kinesia or bradykinesia
        4) Rigidity of muscles
        5) Tremors (resting)

3. Alzheimer's Disease
    a. Description: a devastating, progressive degenerative disease resulting in structural damage in brain → neurotransmitter imbalance within hippocampus:
        1) ↓ Ach
    b. Cause: unclear; linked to genetic and autoimmune factors
    c. Key s/sx:
        1) impaired memory and judgment
        2) confusion and disorientation
        3) inability to recognize family and friends
        4) changes in behavior: aggression, depression, anxiety, psychosis
4. Muscle Spasms/Muscle Spasticity:
    a. Description:
        1) muscle spasms – involuntary contractions of a muscle or groups of muscles
        2) muscle spasticity – when groups of muscles remain in a state of continuous contraction
    b. Causes:
        1) excessive muscle use
        2) local injury to skeletal muscle
        3) adverse effects of antipsychotics
        4) seizure disorders
        5) electrolyte imbalances (e.g. hypocalcemia)
        6) other debilitating neurological/N-M disorders
    c. Consequences of muscle spasms (often related inflammation and edema 2° injury):
        1) pain
        2) tightness/resistance in movement
        3) ↓ coordination and mobility
        4) others depending on involved muscle(s)

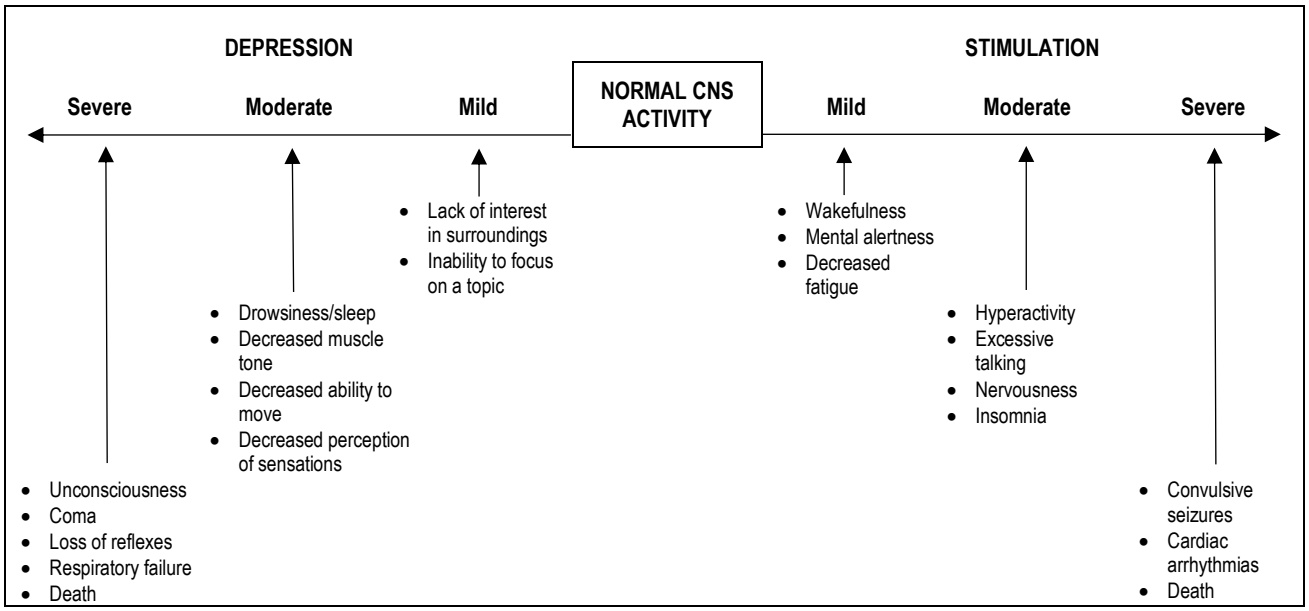
V. PHARMACOLOGY

A. Pharmacologic Connections for CNS Agents

1. Alteration in CNS function is related to abnormal nerve impulse transmission – this can be the result of:
    a. Neurotransmitter imbalance ⇨ signs and symptoms of CNS disorders*
    b. Complex mechanisms that regulate neurotransmitters:
        1) ↑ or ↓ number of sensitivity of receptors
        2) acid-base imbalances
        3) hypoxia

2. CNS medications are often used to affect the normal action of a neurotransmitter (mimic or block) based on the neurotransmitter imbalance caused by various neurological conditions

3. CNS agents can cause either an excitatory (stimulatory) or inhibitory (depressive) effect on the CNS depending on the normal function of the neurotransmitter:
   a. CNS depressants slow down the brain by:
      1) ↓ excitatory neurotransmitters or blocking their receptor sites
      2) ↑ inhibitory neurotransmitters
   b. CNS stimulants ↑ brain activity by:
      1) ↓ inhibitory neurotransmitters or blocking their receptor sites
      2) ↑ excitatory neurotransmitters
   c. Continuum of CNS effects caused by CNS agents:



Nursing Implications: CNS – Mental Health: Sedative-Hypnotics/Antianxiety – Overall Outcome of Drug Effects: CNS Depression

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
barbiturates	↑ GABA *(mimics action)*	phenobarbital	Lumina	Route: PO/IV (avoid IM) Schedule (II) Preg. risk cat.=D	• ↓ s/sx anxiety (↓ fatigue, restlessness ↓ fearful feelings or feelings of dread, ↓ difficulty concentrating) • ↑ sleep Other uses: • ↓ seizures • promote pre-op sedation	• Potential for dependence • Low safety margin • CNS → ↑ respiratory depression • Other vitamin deficiencies (Vit. D & K) • Induces drug-metabolizing enzymes → tolerance/cross-tolerance	• Use only as directed • Safety precautions, esp. older adults • Report ↑ CNS depression • Ø abruptly stop • Ø alcohol or other CNS depressants • Avoid herbal preparations ○ St. John's Wort	• Take several wks for therapeutic effect • Avoid prolonged use • Contraception
benzodiazepines	↑effects of GABA ↑total sleep time (some ↓non-REM, ↑REM)	diazepam triazolam alprazolam lorazepam	Valium Halcion Xanax Ativan	Route: PO/IV Short-term Schedule IV ↑ half-life Preg. risk cat.=D	• ↓ s/sx anxiety (as listed above) • ↑ sleep Other uses: • ↓ Seizures • ↓ Muscle spasms • ↓ Alcohol withdrawal • promote pre-op sedation	• Dependence • CNS → respiratory depression (less then barbiturates) • IV route: CVR depression ***Antidote:*** flumazenil (Romazicon)		• Avoid prolonged use • Contraception
Non-benzodiazepine/ non-barbiturate (or benzodiazepine-like)	↑ dopamine receptors (presynatically) → effects serotonin receptors	buspirone	BuSpar	Mgmt of GAD Route: PO Ø grapefruit juice Preg. risk cat.=C	• ↓ s/sx anxiety (as listed above)	• GI: N/V • CNS: dizziness, drowsiness; less interaction w/ other CNS depressants • ↓ potential dependency/ withdrawal		• Takes several wks to achieve optimal effect • Contraception

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
non-benzo/non-barb	↑effects of GABA; preserves stages III & IV sleep w/ minor REM effects	zolpidem	Ambien	Route: PO Timing: give ***immediately*** before HS Short-term use Schedule IV Preg. risk cat.=C	• Improved sleep	• GI: mild nausea, diarrhea • CNS: daytime drowsiness • Sleepwalking/sleep eating • Mental status △'s (rare)	• Use only as directed • Safety precautions • Report ↑ CNS depression • Ø alcohol or other CNS depressants	• Do not open, chew, crush time-release tabs • Timing: take just before bed • Contraception
melatonin agonist	Activation of melatonin receptors – to regulate circadian clock located in the suprachias-matic nucleus (SCN) of the hypothalamus	ramelteon	Rozerem	Route: PO Timing: 30 min. before HS; take on empty stomach		• CNS: sleepiness, dizziness, fatigue • Endo: amenorrhea, ↓ libido, difficulty w/ fertility, galactorrhea		• Timing: take 30 min. before bedtime on empty stomach • Diet: avoid high-fat meals before taking
Antidepressant – atypical	Serotonin antagonist & reuptake inhibitors (SARIs) blocks serotonin type 2 receptors & inhibits the reuptake of serotonin	trazodone	Desyrel, Oleptro	Route: PO Timing: take on empty stomach	• Improved sleep • ↓ s/sx anxiety (↓ fatigue, restlessness ↓ fearful feelings or feelings of dread, ↓ difficulty concentrating) Other uses: • reduce depression	• CNS: somnolence, sedation, dizziness • GI: constipation • Vision: blurred		

Nursing Implications: CNS – Mental Health: Antidepressants –
Overall OUTCOME OF Drug EFFECTS: CNS DEPRESSION or CNS STIMULATION

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
monoamine oxidase inhibitors (MAOI)	Inhibits monoamine oxidase (enzyme that terminate actions of NTs): dopamine, norepinephrine epinephrine, serotonin → ↑ availability & effects of NTs	phenelzine selegiline	Nardil Emsam, Zelapar, Eldepryl	Route: PO ✓BP Avoid foods high in tyramine Preg. risk cat.=C Contraindications: CV dz, seizure disorder	• ↑mood, improved affect Other uses: • Parkinson's dz	• CV: ↓BP, dizziness; or ↑BP if ingesting foods ↑tyramine • CNS stimulation: irritability, delirium, mania, anxiety • GI: constipation, anorexia, dry mouth • Repro: sexual dysfunction	• Take as directed • Do not abruptly stop • Safety for CNS effects • Avoid other CNS depressants • Report: Mood △'s, esp. suicidal ideations • Consider therapies for tx (psychotherapy, counseling, phototherapy, ECT)	• Takes 4-8 wks to achieve full effects • Contraception • Report adverse effects, esp.: ○ CNS ○ CV • Teach re: foods ↑ in tyramine • Avoid caffeine • Teach re: ✓BP • Teach re: drug-drug interactions – herbal supplements • DDI: TCAs, SSRI
tricyclic antidepressants (TCA)	Inhibits reuptake of norepinephrine & serotonin into presynaptic terminals →↑ effects of norepinephrine & serotonin; also blocks receptors: • Muscarinic • Cholinergic • Histamine1 • α1 adrenergic	amitriptyline imipramine	Elavil Tofranil	Route: PO/ IV (↑ protein-bound, ↑ T ½ → loading dose) Preg. risk cat.=C Contraindications: CV dz, seizure disorder	• ↑mood, improved affect Other uses: • enuresis • anxiety disorders • intractable pain • withdrawal sx	• CV: dysrhythmias, BP (orthostatic) • CNS: sedation, drowsiness • ENT: blurred vision • GI: wgt gain • Suicidal ideation; other mood changes • Anticholinergic effects: dry mouth, photophobia, urinary retention, constipation • Repro: sexual dysfunction		• Take 4-8 wks to achieve full effects • Contraception • Report adverse effects, esp.: ○ CV ○ sexual dysfunction • Take at bedtime to minimize daytime sleepiness • Multiple DDIs: MAOIs • Increase fluids & fiber • Sunglasses • Chew sugarless gum

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
selective serotonin reuptake inhibitors (SSRI)	Inhibit reuptake of serotonin at presynaptic terminals →↑ availability/ effects of serotonin • more selective in its effects	fluoxetine sertraline paroxetine escitalopram	Prozac Zoloft Paxil Lexapro	Route: PO Timing: AM (↑ protein-binding → ↑ duration of action) Do not give w/ MAOIs Preg. risk cat.=C/D Contraindications: give w/ caution to children & adolescents	• ↑ mood, improved affect • Other mental health – anxiety • PMS, PDD	• CNS stimulation • GI: N/V/D/A, wgt gain • HA • Repro: sexual dysfunction • TOXICITY: Serotonin syndrome (SES) * **Know s/sx (HARMED) & how it is precipitated**	• Take as directed • Do not abruptly stop • Safety for CNS effects • Avoid other CNS depressants • Report: Mood △'s, esp. suicidal ideations • Consider therapies for tx (psychotherapy, counseling, phototherapy, ECT)	• Takes 5 wks to achieve max effects • Give: AM • Timing: take earlier in day for insomnia • Take w/ food for ↓GI effects • Ø herbal supplements or other antidepressants • Ø alcohol consumption • Contraception • For SES →STOP meds, call 911
miscellaneous antidepressants: SNRI = serotonin-norepinephrine reuptake inhibitor	Inhibits reuptake of serotonin, norepinephrine, dopamine	bupropion venlafaxine duloxetine	Wellbutrin, Zyban Effexor Cymbalta	Route: PO Preg. risk cat.=B/C	• ↑ mood, improved affect Other uses: • smoking cessation →↓ nicotine withdrawal • pain due to fibromyalgia, chronic & neuropathic pain	• GI: N/C, dry mouth, wgt loss • CNS stimulation • Other: HA, ↑ HR		• Takes 1-3 wks to achieve effects • Ø alcohol consumption • ✓ other drugs

Nursing Implications: CNS – Mental Health: Mood-Stabilizers

Sub Class	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
antimanics Other drug classes: • antiepileptics • atypical antipsychotics	↑reuptake of NE & serotonin →↓ receptor sensitivity →↓ catecholamine release/effects	lithium	Eskalith, Lithobid	Route: PO Preg. risk cat.=D	• Ø mania • Ø or ↓ manic/ depressive episodes • ✓ serum drug level (note – *narrow therapeutic range*)	• GI: N/V/D/A • GU: polyuria, ***nephrotoxicity*** (renal failure) • Endo: hypothyroidism • CNS △'s – hand tremors * ***Know predisposing factors of lithium toxicity:*** ○ mild: apathy, lethargy, mild mm weakness, ↓ concentration, mild ataxia/tremors, twitching ○ moderate: N/V/D, moderate ataxia/ tremors, incoordination, slurred speech, tinnitus, blurry vision ○ severe: nystagmus, irreg. tremor, deep tendon hyperreflexia, visual or tactile hallucinations, ↓ LOC, oliguria/ anuria, seizures, coma, death	• Take as directed • Do not abruptly stop • Safety for CNS effects • Avoid other CNS depressants • Report: Mood △'s ○ suicidal ideation • Consider therapies for tx (psychotherapy, counseling, phototherapy, ECT)	• Takes 2-3 wks to achieve full effects • Contraception • Timing: take w/ food • Diet: moderate sodium & fluid intake • Avoid caffeine • Teach re: other meds – ✓ w/ MD • Report: ○ CNS △ ○ GU △ ○ Wgt △ • F/U tests: ✓ ○ drug levels – BUN, Cr, EGFR – CBC – Lytes – thyroid

Nursing Implications: CNS – Mental Health: Anti-Attention Deficit/Hyperactivity Disorder Agents

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
CNS stimulants	Stimulate specific areas of CNS (RAS) to heighten alertness & increase focus by ↑NT: • NE • Dopamine • serotonin	methylphenidate	Ritalin Concerta	Route: PO Schedule II Preg. risk cat.=C	↓ s/sx ADHD: • ↓impulsiveness • ↓hyperactivity • ↓disruptive behavior • ↑psychosocial interactions • ↑academic performance Other uses: • narcolepsy • obesity – wgt loss • mood elevation	• When given for: ADHD: CNS: sedation, drowsiness • When given for: Non-ADHD: CNS: stimulation ↑ • GI: N/A, abd pain, wgt loss • CV: ↑BP, dysrhythmias • CNS: seizures • Dependency → tolerance & withdrawal reaction	• Monitor academic performance • Good nutrition • Weigh regularly	• Takes 2-3 wks to achieve full effects • Consider 'drug holidays' • Timing: do <u>not</u> take after 4 pm • High risk pts: ✓ BP/HR • Secured storage
Selective norepinephrine reuptake inhibitors	Inhibit reuptake of NE →↑ availability/ effects of NE • non-CNS stimulant	atomoxetine	Strattera	Route: PO	↓ s/sx ADHD (as above	• GI: N/V/A, wgt loss, growth suppression, hepatotoxicity • Psych: suicidal ideation syndrome • CNS: seizures		• Takes at least 1-3 wks to see effects • Give: AM, AM/PM

Nursing Implications: CNS – Mental Health: Antipsychotics

Subclass	MOA	Prototype – generic	Prototype – trade	A– Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – General (SC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – General (SC)
Typical or conventional	Block dopamine Type 2 (D2) receptors → ↓ dopamine to RAS & extra-pyramidal tract • CNS depression • ANS depression	chlorpromazine haloperidol	Thorazine Haldol	Route: PO Route: PO/ IM	↓ s/sx **schizophrenia** • + signs Other uses: • ↓N/V • Ø hiccups Other uses: • ↓ dementia	• CNS depression ○ ↑sedation ○ ↓respiratory • Anti-adrenergic ○ ↓ BP (O) w/ ↑HR ○ dizziness, faintness, fatigue • Anti-cholinergic ○ dry mouth ○ blurry vision ○ ↓GI/GU fn. • Hypersensitivity • Skin: photo-sensitivity • Endo: sexual dysfunction, ↑ prolactin & libido • Neuroleptic malignant syndrome (NMS) – more w/ typical (F-E-V-E-R) • Heme: agranulocytosis (rare)	• EPS ○ dystonia ○ parkinsonism ○ akathisia ○ tardive dyskinesia	• Take as directed • Do not abruptly stop • Safety for CNS effects: orthostatic BP • Report: Mood △'s • Consider therapies for tx (psychotherapy, counseling, phototherapy, ECT) • Takes wks to achieve full effects • Timing: HS 2° sedation • For anti-cholinergic effects: ○ ↑fiber ○ ↑fluids • Sunglasses • Sunscreen • Report: ○ menstrual △ ○ sexual problems • STOP for NMS, 911 • F/U labs: ○ BUN, CR, EGFR ○ ALT, AST ○ CPK ○ CBC • Avoid CNS depressants • Diet: wgt maintenance • Ø smoking • Ø caffeine	• Report EPS – Stop, ↓, or △: ○ Add: anti-Parkinson's agents – benztropine ○ Add: anti-histamines ○ Add: benzo-diazepines
Atypical	Block dopamine Type 2 (D2) receptors → ↓ dopamine to RAS & extra-pyramidal tract (***loosely bound***): • blocks serotonin • ANS depression	risperidone clozapine aripiprazole olanzapine quetiapine	Risperdal Clozaril Abilify Zyprexa Seroquel	Route: PO/ IM/IV Preg. risk cat.=B/C	↓ s/sx **schizophrenia** • + signs • - signs Other uses: • narcolepsy • obesity – wgt loss • mood elevation - bipolar		• ↑BG • ↑cholesterol • Wgt gain • Mild EPS – less risk of NMS		• F/U labs: ○ BG ○ Lipids ○ Cholesterol levels

Nursing Implications: CNS – Neurologic/Neuromuscular Disorders: Antiepileptics/Antiseizure Agents

Overall Outcome of Drug Effects: CNS Depression

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
barbiturates	↑ GABA *(mimics action)* ↑Cl- influx	phenobarbital	Lumina	Route: PO/IV (avoid IM) Schedule II (IV) Preg. risk cat.=D	• Ø or ↓seizures • (most common – epilepsy) Other uses: • improved sleep	• Potential for dependence • Low safety margin • CNS – ↑respiratory depression • Other vitamin deficiencies (Vit. D & K) • Induces drug-metabolizing enzymes → tolerance/cross-tolerance	• Use only as directed • Contraception • Safety precautions, esp. older adults • Report ↑ CNS depression • Ø abruptly stop • Ø alcohol or other CNS depressants • Report any sudden △ in mood or affect – esp. suicidal behavior • Avoid herbal preparations – St. John's Wort	• Takes several wks for therapeutic effect • Avoid prolonged use
benzodiazepines	↑effects of GABA (*enhances* action) ↑Cl- influx	diazepam	Valium	Route: PO/IV Short-term Schedule IV ↑ half-life Preg. risk cat.=D	• Ø or ↓seizures • (status epilepticus) Other uses: • ↓s/sx anxiety (↓ fatigue, restlessness, ↓ fearful feelings or feelings of dread, ↓ difficulty concentrating) • ↑sleep • ↓muscle spasms • ↓alcohol withdrawal • promote pre-op sedation	• Dependence/tolerance • CNS – respiratory depression (less than barbiturates) • IV route: CVR depression • ***Antidote:*** flumazenil (Romazicon)		• Avoid prolonged use

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
hydantoins	↓Na^+ influx	phenytoin	Dilantin	Route: PO/IV (↑ protein-bound, ↑ T ½ → loading dose) Preg. risk cat.=C	• Ø or ↓seizures • ✓ serum level Other uses: • Improved cardiac rhythm	• CNS: nystagmus, sedation, ataxia double-vision, cognitive impairment • Heme: blood dyscrasias • CV: dysrhythmias, ↓BP (IV) • Neuro: peripheral neuropathy • Hypersensitivity • Integ: gingival hypertrophy, skin reactions	**(See previous page)**	• F/U tests: ✓ drug levels; ✓CBC, ✓ renal & liver fn. • Regular dental care
succinimides	↓Ca^{++} influx	ethosuximide	Zarontin	Route: PO	• Ø or ↓seizures – petit mal – "absence" = zero	• CNS: dizziness, HA, lethargy, ataxia • Psych: behavioral △'s • Heme: blood dyscrasias • GI: N/V, abd. distress, wgt loss • Integ: gingival hypertrophy		• Report: ○ behavioral △'s ○ wgt loss – give w/ food • ✓ CBC • Regular dental care

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – ✓ Therapeutic Effects – General (MC)	A – ✓ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
miscellaneous AEDs	↓ Na^+ influx ↑ GABA (phenytoin-like)	valproic acid	Depakote, Depakene	Route: PO/IV Preg. risk cat.=D	• Ø or ↓seizures • ✓ serum level Other uses: • Stabilize mood	• Alternative to phenytoin • GI: N/V/D/A/ abd. pain, hepatotoxicity • CNS: HA, tremor, dizziness • Heme: thrombocytopenia	**(See previous page)**	• ✓ blood level per MD orders • Labs: ○ ✓ liver function tests
		carbamaze-pine lamotrigine	Tegretol Lamictal	Route: PO	• Ø or ↓seizures • ✓ serum level Other uses: • ↓neuropathic pain • ↓s/sx Alzheimer's • dementia • ↓manic episodes	• Well tolerated; adv. effects transient • CNS: dizziness, blurry vision • GI: N/V • Induction of drug-metabolizing enzymes • Heme: blood dyscrasias		• ✓ blood level per MD order • ✓ CBC
	mechanism unclear – ↓Ca^{++} channels →↓glutamate, norepinephrine & substance P	gabapentin pregabalin	Neurontin Lyrica	Route: PO Preg. risk cat.=C	• Ø or ↓seizures Other uses: • ↓neuropathic pain • ↓fibromyalgia	• Newer AEDs • CNS: dizziness, somnolence, headache • GI/GU: weight gain, dry mouth, peripheral edema • Hypersensitivity		• ✓ weight – report increases • ✓ fluid retention

Nursing Implications: CNS – Neurologic/Neurological Disorders: Anti-Parkinson Agents

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
dopaminergics →↑ dopamine and/or its effects	↑dopamine synthesis	levodopa	Laradopa, Sinemet*, Stalevo**	Route: PO Do <u>not</u> give w/: • Iron • High protein meal • Give meds w/ food	↓ s/sx Parkinson's dz - improved: • mobility • balance • gait • speech • self-care ability	• CV: orthostatic hypotension; dysrhythmias • GI: N/V/A • CNS stimulation: ○ insomnia ○ MS △ ○ psychosis • MS: Dyskinesia r/t duration • Other: ○ discoloration of sweat, urine & skin ○ for MAO-B inhibitors – hypertensive crisis triggered from foods containing tyramine	• Use only as directed • Safety precautions • Report CNS depression, disorientation • Ø abruptly stop → Parkinsonism crisis • Ø alcohol or other CNS depressants	• Gradually ↑dose to max; can take up to 6 mos • △ position slowly • Avoid high protein intake, Vit. B_6 • ✓ VS • Report if: unable to stay awake • ✓ liver/renal function • Contraception • Lots of DDIs
	dopamine agonists – activate dopamine receptors	pramipexole	Mirapex					
	dopamine releasers – activate dopamine reuptake	amantadine	Symmetrel					
	catecholamine-O-methyltransferase (COMT) inhibitors – blocks breakdown of levodopa	entacapone	Comtan					
	monoamine oxidase –B (MAO-B) inhibitors – blocks breakdown of dopamine	selegiline	Eldepryl					
anticholinergics	blocks Ach – centrally-acting	benztropine	Cogentin	Route: PO Used: early stages of dz	↓ s/sx Parkinson's dz: • ↓ tremor • ↓ salivation, drooling • ↓ sweating	Blocks PNS effects: • GU: urinary retention • GI: constipation • CV: ↑HR, ↑BP • Dry mouth • Mydriasis • Sexual dysfunction		• Take w/food • Manage effects: ○ gum ○ fluids ○ fiber • Report: visual changes

Nursing Implications: CNS – Neurologic/Neurological Disorders: Anti-Alzheimer's Agents

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
acetyl-cholinesterase inhibitors	↑ effect of Ach (in CNS) →↑ enhances action of the PNS	donepezil	Aricept	Route: PO Long t ½ →1x/day Timing: give at bedtime	↓ s/sx Alzheimer's dz: • improved function & cognition • improved memory	• GI: N/V/D • GU: urinary freq., incont., darkened urine • CNS: insomnia, irritability, depression, syncope • MS: muscle cramps, bone fx • ↑ libido, hot flashes, blurred vision	• Use only as directed • Safety precautions	• Timing: give w/ food • Max effects take ~6 mos • Report any △ in mental status or mood or presence of adverse effects
N-methyl-D-aspartate (NMDA) receptor antagonists	↓ neural effects of glutamate →↑ neuronal calcium overload	memantine	Namenda	Route: PO Freq: 1-2x/day		• CNS: dizziness, HA, confusion • GI: constipation		

Nursing Implications: CNS – Neurologic/Neuromuscular Disorders: Muscle Relaxants

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General – (MC)	T – Teaching – Specific (SC)
benzodiazepines	CNS depression by: • ↑ GABA • ↑ Cl influx	diazepam	Valium	Route: PO/IV Schedule IV Preg. risk cat.=D	↓ muscle spasms • Improved sleep • ↓ anxiety • ↓ or Ø seizure • Manage ETOH withdrawal	• Dependency • Higher safety margin • ↑ CNS depression • CVR depression w/ IV infusion ANTIDOTE: flumazenil (Romazicon)	• Use only as directed • Safety precautions • Report ↑ CNS depression • Ø abruptly stop • Ø alcohol or other CNS depressants • Additional complementary measures: ○ gentle massage ○ positioning/ ROM ○ heat/cold application ○ physical therapy	• Use contracep-tion • Avoid prolonged use
centrally-acting	CNS depression at brain stem by inhibiting catecholamine (NE) reuptake	cyclobenzaprine	Amrix, Flexeril	Route: PO Short-term use only	↓ muscle spasms 2° musculoskeletal injury: • ↓ pain • ↑ ROM	• CNS depression – drowsiness, blurred vision, dizziness • Other anticholinergic effects – dry mouth, urinary hesitancy or retention, constipation • Hepatotoxicity ANTIDOTE: for anticholinergic effects/ overdose: ○ physostigmine salicylate		• Report GI sx – N/V, jaundice • F/U liver function tests
	GABA agonist; its primary site of action → spinal cord	baclofen	Lioresal	Route: PO; Intrathecal (via implantable pump) Long-term use	↓ muscle spasticity 2° neurological disorders • ↓ pain • ↑ ROM	• CNS depression – drowsiness, dizziness, fatigue • GI: N/C • GU: urinary retention		• Report urinary retention • ↑ fiber in diet • Take w/ meals

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General – (MC)	T – Teaching – Specific (SC)
Peripherally-acting or direct-acting	Works directly at muscle tissue → blocks release of Ca^{++} ions in skeletal muscle → muscle relaxation	dantrolene	Dantrium	Route: PO Long-term use	↓muscle spasticity 2° neurological disorders: • ↓pain • ↑ROM Other uses: • Treats malignant hyperthermia r/t general anesthesia	• NM: muscle weakness • GI: N/V/D, Hepatotoxicity • CV: tachycardia, △'s in BP	**(See previous page)**	• Report GI sx – N/V, jaundice • F/U liver function tests

Nursing Implications: CNS – Neurologic/Neuromuscular Disorders: Neuromuscular Blockers

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General – (MC)	T – Teaching – Specific (SC)
Depolarizing – binds to Ach receptors → produces a state of continuous depolarization → brief repeated muscle movements → muscle relaxation	Competes w/ Ach at cholinergic (nicotinic) receptor sites on motor end plate; starts w/ muscle relaxation → ***muscle paralysis***	succinylcholine	Anectine	Route: IM/IV	+ muscle paralysis for: • muscle relaxation during surgery • Ø spontaneous breathing during intubation • Ø seizures during ECT	• ↓RR, respiratory arrest – apnea • CV: ↓ BP • malignant hyperthermia • hyperkalemia • pain	• Drug effects – will <u>not</u> make unconscious or reduce pain: ○ give pain meds ○ turn/position • Patient cannot speak • Will be continuously monitored during therapy – life support measures	• Have life support measures on hand
Non-depolarizing – competes w/ Ach at receptor sites → muscles remain relaxed		pancuronium	Pavulon					

Nursing Implications: CNS – Pain Management: Anesthetics –
Overall Outcome of Drug Effects: CNS Depression

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
Local	Block sodium channels → block nerve impulse transmission to a defined area	lidocaine benzocaine	Xylocaine Orajel	Methods of administration: • surface: topical • infiltration: IM • nerve blocks: IM • spinal • epidural Use of adjunctive meds: • epinephrine • sodium bicarbonate	• ↓sensation • →Ø pain • ↓blood loss	• Dose- & technique-dependent • Systemic effects w/ ↑doses: ○ CNS excitement, irritability, confusion ○ respiratory depression ○ CV – hypo-tension dysrhythmias • Specific safety risks: ○ aspiration ○ tissue trauma ○ falls/injuries • Hypersensitivity	• Use only as directed • Report ↑CNS depression • Safety precautions	• Proper technique • Specific safety risks based on method of administration: ○ + gag ○ NPO ○ bedrest, proper positioning • Give test dose • Give antihistamine
General: inhalation	CNS depression → LOC ***Know stages/order of general anesthesia*** 1) loss of pain 2) excitement & hyperactivity 3) surgical anesthesia 4) medullary paralysis ⇒ respiratory & CV paralysis	isoflurane halothane nitrous oxide	Forane Fluothane	NPO + use of pre-anesthetic meds = balanced anesthesia	↓ LOC → uncon-sciousness, Ø pain: • ↓reflex activity • ↓adverse effects • awake easily w/ protective reflexes intact	• CV: ↓BP, ↓HR: R: ↓RR • CNS: ↓/△ LOC, ataxia • ↓body temp. • GI: N/V, hepatotoxicity • Malignant hyperthermia → <u>give</u> treat w/ dantrolene (Dantrium)		• Safety – restraints, side rails, restricted activity • Close monitoring by nurse in recovery room • Continuous ECG monitoring • ***✓O_2sat – give O_2, C & DB*** • Reposition • Manage other tubes
General: intravenous		propofol fentanyl midazolam	Diprivan Sublimaze Versed					

Nursing Implications: CNS –Pain Management: Analgesics
Overall Outcome of Drug Effects: Block pain centrally or peripherally

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
opioid agonists /narcotics	Acts on opioid receptors (i.e. mu, kappa, sigma, delta, epsilon) in brain for analgesia → CNS depression	morphine sulfate codeine fentanyl	Astramorph PF, Duramorph	Route: PO/IM/ IV Schedule II Rate pain before admin. ✓ VS, esp. RR	• ↓pain moderate to severe • ↑relaxation • ↓cough • ↓bowel motility	• CNS: drowsy →coma • CVR: ↑depress-ion (↓BP, ↓RR, ↓O2) • GI: N/V/A/C • GU: urinary retention • Tolerance/Cross-tolerance/ dependency **ANTIDOTE: naloxone (Narcan, Evzio)**	• Take as directed – proper admin/ dose/ frequency • Hold for RR < 12 • Report: ○ adv. effects ○ Ø pain relief by reas-sessing pain	• Safety for CNS effects – slow position changes • Avoid other CNS depressants • Timing: take w/ food • Diet: ↑fiber, fluids • Watch for dependency • Proper use of naloxone injector product
opioid agonists /antagonists	• Activates opioid kappa receptors in brain for analgesia, sedation, ↓ GI motility • Inhibits opioid mu receptors that cause analgesia, *euphoria, respiratory depression,* sedation, physical dependence • ↓GI motility	butorphanol	Stadol	Route: IV/IM Rate pain before admin. ✓ VS, esp. RR	• ↓pain moderate	Same as opioids ***Except less:*** • Resp. depression • Euphoria • Dependency • Abstinence syndrome • ↑ICP – HA		

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
nonsteroidal antiinflam-matory drugs (NSAID)–	***non***-selective • Inhibit cyclooxygenase (type 1 & type 2), enzymes responsible for prostaglandin synthesis (1st generation NSAIDS)	aspirin	ASA	Route: PO Dose varies Low-dose ASA → antiplatelet	• ↓pain mild to moderate • ↓inflammation • ↓fever • ↓platelets • →Ø clots	• GI: N, abd. pain, dyspepsia/heartburn; gastric ulcers/GI bleed in high doses • GU: renal dysfunction (long-term use) • **Salicylism** (salicylate toxicity): tinnitus, sweating, HA, dizziness, resp. alkalosis • **Reye syndrome (rare) – children/teens**	• Take as directed – proper admin/ dose/ frequency • Report: ○ adv. effects ○ Ø pain relief • Avoid w/bleeding disorders, PUD, renal, hepatic, if taking other anticoagulants • Give w/ food; take w/ plenty of fluids • Report s/sx GI bleed: black, tarry stools, N/V/abd. pain; may take gastric acid inhibitor • Report any ↓ urine output; ✓ renal fn tests • STOP one (1) wk before surgeries • Ø alcohol • DDIs	• Do not give to children/teens w/ s/s viral infection
		ibuprofen naproxen	Motrin, Advil Aleve	Route: PO	• ↓pain mild to moderate • ↓inflammation • ↓fever	• GI: N, abd. pain, dyspepsia/heartburn; gastric ulcers/GI bleed in high doses • GU: renal dysfunction (long-term use)		• Do not give if ↓ renal function
	Selective – COX-2 more specific to prostaglandins assoc. w/pain & inflammation (2nd generation NSAIDS)	celecoxib	Celebrex	Route: PO Contraindica-tions: CV dz	• ↓pain mild to moderate • ↓inflammation	• GI: N, abd. pain, dyspepsia/heartburn; gastric ulcers/GI bleed in high doses • GU: renal dysfunction (long-term use) • **↑ MI/stroke risk**		• Do not give if h/o CV disease

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
nonopioids/ nonnarcotics	Inhibits prostaglandin synthesis centrally in hypothalamus → dilation of peripheral vessels → enables sweating & loss of body heat	acetaminophen	Tylenol	Route: PO/ PR/IV	• ↓pain mild to moderate • ↓fever	• GI: minor GI irritation • Overdose: nephrotoxicity, hepatotoxicity – N/V, chills, abd. discomfort ***ANTIDOTE: acetylcysteine (Acetadote)***	• Take as directed – proper admin/ dose/ frequency • Report: ○ Adv. effects ○ Ø pain relief	• Avoid w/ ***liver dz, alcoholism,*** renal dz • ***Maximum daily dose not to exceed 4000 mg or 4 gm/day*** • Enc. fluids for fever • Report: GI sx • Ø alcohol • F/U tests: liver/renal tests • Contact MD for persistent ↑T
opioid-nonopioid combinations	Possess similar actions of morphine & acetaminophen	hydrocodone & acetaminophen	Norco	Route: PO	• ↓pain moderate to severe	• See those for opioid agonist • See those for acetaminophen		• *Refer to those for opioids & non-opioids* • Watch for dependency

Subclass	MOA	Prototype – generic	Prototype – trade	A – Admin	T – √ Therapeutic Effects – General (MC)	A – √ Adverse Effects – Specific (SC)	T – Teaching – General (MC)	T – Teaching – Specific (SC)
Antimigraine Agents	Selective serotonin type 1 agonist → constrict certain intracranial vessels → ↓ blood flow ↓ inflammation →↓ pain	sumatriptan	Imitrex	Route: PO/ SL/SQ/IN/PR Give: before migraine has reached severe level Contraindica-tion: HTN, CV disease	Stop or ↓ freq. of migraines	• Dizziness, drowsiness, warming sensation • Chest sx (heavy arms, chest pressure) • **Angina (esp. w/ h/o CV dz)**	• Take meds immediately after onset of sx • Avoid w/ ***CV dz, HTN*** • Contraception during use • Avoid migraine triggers	• Avoid herbal remedies • Report ASAP: ○ chest pain
	Selective serotonin (5-HT) agonist; also interact w/ adrenergic & dopaminergic receptor	ergotamine	Ergostat	Route: PO/ SL/PR Preg. risk cat.=X Contraindica-tion: HTN, CV disease, renal/liver dysfunction		• GI: N/V • N-M (ergotism): ○ muscle pain ○ paresthesias in fingers & toes ○ peripheral ischemia • Dependency		• Report ASAP: ○ peripheral vasoconstricting effects
	Inhibits neuromuscular transmission by blocking release of Ach from axon terminals innervating skeletal muscle → muscles relax ⇒ ↓ pain sensitivity	onabotulinum-toxin A	Botox	Route: IM		• Sore neck (at injection sites) • Problems swallowing, speaking or breathing	• IM injections given in specific muscles of head & neck – 31 injections in 7 key areas of head & neck	• Report serious adverse effects • Manages migraines for up to 3 mos

Nursing Implications: CNS – Substance Use: Withdrawal/Abstinence Maintenance Agents

Subclass	MOA	Prototype – generic	Prototype – trade	Administration	✓ Therapeutic Effects	✓ Adverse Effects	Pertinent Teaching
Alcoholism Tx	CNS depression to manage delirium tremors (DTs)	(benzodiazepine or other antiseizure agent)		• ATC until acute withdrawal has passed (starts 72 hrs after last drink): ○ IM/IV	↓withdrawal sx: • abdominal cramping, vomiting, tremors, ↑BP, ↑HR, ↑T, seizures, delirium ↓relapses w/ no s/sx of alcohol abuse (extreme somnolence, CNS depression, diminished reflexes, respiratory depression)	• Refer to earlier Neuro. Pharm section	General: (for all substance abuse): • take abstinence maintenance/ withdrawal agents as prescribed • provide safety measures during detox • provide emotional support to patient & family • encourage participation in abstinence programs • encourage mental health counseling
	Aversion therapy by causing GI upset if alcohol is consumed while taking agent	disulfiram	Antabuse	• Give following detox: ○ oral		• GI: N/V/D – mild • Contraindications: pregnancy	
	Opioid antagonist	naltrexone	Vivitrol, Revia	• Used to reduce alcohol craving		• GI upset • Can ↑risk of opioid overdose	
	Restores neuronal excitation	acamprosate	Campral	• Used to reduce unpleasant abstinence effects		• GI: N/D, flatulence	
Narcotic Addiction Agents	Oral opioid to substitute for ↑ risk opioids (i.e. heroin)	methadone	Dolophine	• Used for both detox & maintenance: ○ oral	↓relapses of narcotic abuse with no s/sx opioid abuse (respiratory depression, cyanosis, extreme somnolence, coma) ↓withdrawal sx: • excessive sweating, restlessness, dilated pupils, agitation, tremor, N/V, abd. cramping, ↑HR, ↑BP, muscle spasms	• Similar opioid adverse effects, but ↓euphoric effects; effects last longer	
	Mixed opioid agonist antagonist – replaces opioid	buprenorphine	Buprenex, Butrans, Suboxone				

Subclass	MOA	Prototype – generic	Prototype – trade	Administration	✓ Therapeutic Effects	✓ Adverse Effects	Pertinent Teaching
Nicotine/ Smoking Cessation	Mechanism of action not fully understood; ↑dopamine release →↓sx of nicotine withdrawal	bupropion	Zyban	• Used for smoking cessation ○ oral	↓nicotine craving ↓withdrawal sx: • irritability, anxiety, restlessness, HA, ↑appetite, insomnia, ↓concentration, ↓BP, ↓HR	• Insomnia • Dry mouth	**(See previous page)**
	↑dopamine release →stimulates pleasurable effects of nicotine	narcnicline	Chantix			• GI: N/V • Neuropsy: △ behavior, mood, suicidal thoughts, insomnia, bizarre dreams	
	Nicotine replacement/ substitute	nicotine (transdermal)	Nicotrol, Nicoderm	• Used for smoking cessation: ○ transdermal		• Skin irritation	*Dangerous to continue smoking while using the patch.