N111: Introduction to Pharmacology

Leslie Martinez, MSNEd, RN
Los Angeles County College of Nursing & Allied Health
leslmartinez@dhs.lacounty.gov

Drug Action

Pharmaceutic Phase

Disintegration
- Breaking down of a tablet into smaller particles

Dissolution
- A drug becoming a solution to aid crossing the biologic membrane
Pharmaceutic Phase

- **Excipients**
  - Inert fillers that enhance drug dissolution & absorption
- **Enteric Coated**
  - Resists disintegration in the acidic stomach
- **Teaching considerations**
  - Enhances or interferes with dissolution
  - Dilutes drug concentration = irritation

Pharmacokinetic Phase

1. **Absorption**
   - Movement of drug from GI tract to body fluids
2. **Distribution**
   - Process of drug becoming available to body fluids & tissues

3. **Metabolism**
   - Inactivated by liver enzymes converted:
     1. H2O soluble substance
     2. Metabolite for renal excretion
4. **Excretion**
   - Via urine
     1. Renal dysfunction
     2. Urine pH
Absorption Variables

1. Lipid-soluble & Nonionized
   - Absorbed faster through GI membrane
2. Water-soluble & Ionized (carrier)

Bioavailability

- % of drug that reaches systemic circulation
- **Oral Route**
  - Occurs after absorption & hepatic drug metabolism
  - < 100% bioavailability
  - 3-5 times higher dose than IV dose
- **IV Route**
  - 100% bioavailability

Bioavailability Variables

1. Drug form
2. Route of administration
3. GI mucosa & motility
4. Food & other drugs
5. Liver metabolism changes or inadequate hepatic blood flow
Pharmacodynamic Phase

- Study of drug concentration & the way it effects the body
- **Primary**
  - Desired effect
- **Secondary**
  - Desirable or undesirable effect
Creatinine Clearance

- **CLcr**
- **Most accurate** lab test determining renal function

- **GFR function** = \downarrow CLcr

- **Dose adjusting**
  - Elderly
  - Renal dysfunction

Pharmacodynamic Phase

- **Agonist**
  - Drug that produces a response
  - *i.e.* Isoproterenol; stimulates beta 1 & 2 receptors → HR increase & bronchodilation

- **Antagonist**
  - Drugs that block a response
  - *i.e.* Cimetidine; blocks histamine → prevents gastric acid secretion

Pharmacodynamic Interactions

- **Additive**
  - When two drugs with similar actions are administered simultaneously
  - = sum of the effect of 2 drugs
  - Desirable or undesirable

- **Synergistic (Potentiating)**
  - When two or > drugs are given together, one can potentiate the other (increase effectiveness)
  - Desirable or undesirable
Pharmacodynamic Interactions

- **Antagonistic**
- When two drugs have opposite effect, the meds cancel each other out
- Desirable (antidote) or undesirable
- Common symptoms of drug-drug interactions
  - Nausea, GI upset
  - Headache, dizziness

Toxic Effects

- **Therapeutic Range**
- Range between min & max effective concentration in the blood
- **Therapeutic Index**
- Ratio that measures the margin of the effective dose & the lethal dose
  - Low ~ Narrow margin of safety
  - High ~ Wide margin of safety

Pharmacodynamics

- **MEC** = Minimum Effective Concentration
- **MTC** = Minimum Toxic Concentration
- The time-response curve evaluates three parameters of drug action:
  1. Onset
  2. Peak
  3. Duration
Therapeutic Ranges & Toxic Levels

<table>
<thead>
<tr>
<th>mcg/ml</th>
<th>Therapeutic Range</th>
<th>Toxic Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilantin</td>
<td>10-20</td>
<td>&gt;30</td>
</tr>
<tr>
<td>Tegretol</td>
<td>6-12</td>
<td>&gt;12-15</td>
</tr>
<tr>
<td>Depakote</td>
<td>50-100</td>
<td>&gt;100</td>
</tr>
</tbody>
</table>

**Loading dose**
- Lrg dose to achieve rapid MEC in the plasma

---

Special Considerations

**Side Effects**
- Physiologic effects not r/t desired drug effects
- Teaching opportunity

**Adverse Reactions**
- Unintended, undesirable mild to severe side effects at normal doses
- i.e. Anaphylaxis & Hypersensitivity
- Report & document

---

Peak & Trough

**Peak**
- Indicates rate of drug absorption
- Highest level of plasma concentration at a specific time
- Blood drawn at proposed **peak time**
- Peak time is dependent on route
Peak & Trough

Trough
- Indicates rate of drug elimination
- Lowest level of plasma concentration just before med administration
- Blood drawn minutes before med administration

PEAK AND TROUGH

Peak & Trough
- Narrow Therapeutic Index Meds
  - Aminoglycosides
  - Anticonvulsants
- Gentamicin
  - Peak = 30 min after IV infusion completed
  - Peak 5-10 mcg/dl  Toxic Peak > 12 mcg/dl
  - Trough < 2 mcg/dl  Toxic Trough > 2 mcg/dl
Food & Drug Administration (FDA)

- Protects Public Health by assuring the safety, efficacy & security of:
  - Human & animal drugs, 80% food supply, biological products, medical devices, radiation emitting devices...

- Responsibilities
  - Speeding innovations that make meds more effective, safe & affordable
  - Helping public get accurate, science-based info on meds & foods to improve health

Federal Legislation:
Federal Food, Drug & Cosmetic Act

- Monitors & regulates the manufacturing & marketing of drugs
- Requires approval before marketing
- Clinical Trials
- Labels & packaging

Federal Legislation:
Controlled Substance Act

- Regulation of Controlled Substances
- Narcotic Drug Use & Abuse
  1. Promotion of drug education & provisions
  2. Strengthening of enforcement authority
  3. Establishment of tx & rehab. facilities
  4. Designation of schedules for controlled drugs
Schedule I
- High abuse potential
- No accepted medical use in U.S.
- Not accepted for use under medical supervision
- Heroin, Hallucinogens & Marijuana

Schedule II
- Accepted for medical use
- High potential for drug abuse
- Severe physical & psychological dependency risk
- Meth, Demerol, Morphine, Oxycodone, Cocaine

2.5 years later

Schedule III
- Medically accepted
- Potential abuse < Schedule I & II
- Moderate or low physical dependence or high psychological dependence risk
- Anabolic steroids, Codeine preparations, barbiturates
Schedule IV

- Medically accepted
- May cause dependence
- Limited physical dependence or psychological dependence relative to the drugs in Schedule III
- Phenobarbital, Benzodiazepines, Lorazepam, Valium, Xanax

Schedule V

- Medically accepted
- Very limited potential for dependence
- Cough syrups with codeine, lomotil

Nursing Responsibilities

- Account for controlled substances
- Double lock
- Locked room & Pyxis
- Records/Inventory
- Access to keys
- Countersign ~
- Access to keys
- Waste vs. lost
- Med room
- Morphine 6 mg IVP
- Mandatory abuse reporting
- Scan medications
- Med room
Over the Counter (OTC) Medications

- Advantages
  - Convenience, cost
  - Potential serious complications
- Contraindications
  - Additive effect, non-disclosure, reactions
- Nursing responsibilities/Teaching
  - Reconciliation, use of 1 pharmacy, labels, dosing

Herbal Therapies

- Plant/plant part used for its scent, flavor, or therapeutic property
- >$60 billion annual industry
- Non-FDA regulated
  - Dietary Supplement Health and Education Act 1994
    - Reclassified as “Dietary Supplements”
    - Can note physiological effects
    - Can not state preventative, diagnostic or curative effects

Herbs: Potential Hazards

- Black Cohosh
  - Potentiates effects of insulin, oral hypoglycemic, and antihypertensive drugs
- Goldenseal and Kava
  - Contraindicated in pregnancy
- Licorice (excessive)
  - Increased BP & potassium excretion, lethargy, heart failure
Herbs: Nursing Responsibility

- Complete list of herbal & OTC preparations
- Include teas, tinctures, tablets, and dried herbs
- Name, brand, dose, frequency, side effects and client's perceived effectiveness

Teaching
- Encourage as “integrative” modality
- Potential interactions w/ prescribed medications
  - High risk: elderly & three or more drugs for chronic conditions
- Dietary considerations

Pediatric Considerations

- Pediatric pharmaceutical
- Research/profit margin
- Pediatric Equity Act

Pharmacokinetics
- Absorption: varies by age/weight/health status
- Distribution: affected by body fluid composition
- Metabolism: neonate/infant vs. adolescent
- Excretion: decreased < 9 months and adolescence

Pediatric Considerations

- Family-centered care
- Caregiver teaching
- Cognitive assessment
- Atraumatic care
  - Eliminate/minimize psychological & physical distress of children and their family
Older Adult Considerations

- 85% take medications
- Polypharmacy
  - Multiple HCPs, herbal/OTC therapies, shared/duplicate meds, discontinued meds
- Intentional vs. unintentional noncompliance
- Effects
  - Confusion, falls, malnutrition, renal/liver issues

Older Adult Considerations

- Absorption
- Distribution
- Metabolism
- Excretion
- Dose adjusting
  - Weight, adipose tissue, labs, health problems
- Teaching
  - Use of one pharmacy/Carry list

Nurse Practice Act

- Drug Administration Laws
  - Vary state to state
  - Civil Court prosecution

- Misfeasance
  - Wrong drug or dose resulting in death
Nurse Practice Act

- **Malfeasance**: Correct drug by wrong route that causes death
- **Nonfeasance**: Omission that results in death

Florence Nightingale was the first to set out guidelines for ethical nursing practice...

“It may seem a strange principle to universalize as the very first requirement in a hospital so that it should do the sick you harm.”

Drug Names

- **Trade (Brand) Name**: Tylenol
- **Generic Name**: Universally accepted acetaminophen

Orders: acetaminophen (Tylenol)

Drug Information Resources

1. Nursing Drug Guides
2. Online sites
   - Micromedix (Intranet)
3. Smartphone applications
   1. Davis
   2. Micromedix
   3. Nurse Reference Center
**Black Box Warning: Policy 909**

- Given when **safe administration** of drug carries risk of serious/life-threatening adverse effects
- **Strongest drug warning by FDA**

**LAC+USC BBW list**
1. The Licensed Nurse will review & implement “RN Actions to Consider” prior to administering the drug
2. Report adverse findings on Patient Safety Network

---

**High Alert Medications**

- **Medications** that carry the risk of causing injury **when misused**
- **Safeguard to reduce the risk of error**
  - Limiting access
  - Auxiliary labels and automated alerts
  - Standardizing ordering, storage, preparation, & administration
  - Double checks/signature

---

**Examples:**
- Insulin (subQ & IV)
- Opiates & Narcotics
- Anticoagulants
- Chemotherapy
- Thrombolytics
Joint Commission

2015 National Pt Safety Goals: Hospitals

Goal 1: Improve accuracy of Pt identification
Goal 2: Improve staff communication
Goal 3: Improve medication safety
Goal 6: Improve alarm safety
Goal 7: Reduce HAI risks

LAC+USC Policy 721
Medication Reconciliation

Ensures the development of a complete & accurate list of medications
Pt moves from one area to another
Change in setting
New practitioner
Change in level of care

5 steps of Reconciliation

Nursing Process in Medication Administration

Quality & Safety Education for Nurses (QSEN)

Knowledge, Skills, & Attitude
1. Patient & Family Centered Care
2. Collaboration & Teamwork
3. Evidence-based Practice
4. Quality Improvement
5. Safety
6. Informatics

QSEN Institute

Comprehensive, competency-based resources to empower nurses with knowledge, skills, & attitudes to improve quality & safety across healthcare systems
Assessment

- Systematic validation & documentation of info.
- Subjective Data
  - Current health hx, symptoms, current meds/herbs/OTC, past health hx, and environment
- Objective Data
  - Physical health assessment
    - Gross/fine motor skills, visual impairment, dosing
  - Labs and diagnostics

Nursing Diagnosis

1. Deficient knowledge r/t lack of information about drug interactions and OTC drugs AEB ingesting meds with dangerous additive effect.
2. Impaired urinary elimination r/t decreased fluid volume and renal immaturity AEB UO > 10 mL/hr and Cr level of 2.67.
3. Ineffective health maintenance r/t lack of transportation and income AEB multiple missed appointments and noncompliance with medication.

Planning & Goal

- Goal setting
  - Client centered
  - Specify activity
  - Time frame
- Nursing intervention development
  - Focused on goal attainment
- The client will independently administer prescribed insulin by end of 4th session instruction.
Implementation

- General teaching
- Administration
- Nurse vs. client
- Diet
- Side effects
- Cultural considerations

Evaluation

- Goal evaluation
- Not met/partially met
  - Nursing interventions/plan revision
  - Teaching

Medication Record Sheet

<table>
<thead>
<tr>
<th>Name:</th>
<th>Family Physician:</th>
</tr>
</thead>
</table>

**EXAMPLE**

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Instructions</th>
<th>Reason For Therapy</th>
<th>Duration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Example: Paroxetine, 100 mg: Take 1 tablet every day, with meals.
- Example: Add NIH Stress, Headache: Example: Increase, compel, bleeding, etc.
- Example: Headache, compel, bleeding, etc.