ESRD Pharmacology 101 for Dietitians

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Objectives

✓ Review the biochemical interactions that occur between drugs and the human body
✓ Describe the effects of drugs on cells and tissues
✓ Discuss ESRD patient drug dosing considerations
✓ Provide an understanding of Medication Related Problems (MRPs) experienced by ESRD patients
✓ Describe how food and supplements can interact with drugs
Drugs and Football
Agenda

• Drugs in the Body
• Drug dosing considerations
• Medication Related Problems
• Food/Supplement Interactions
“Drugs are toxins with desirable side effects”
Pharmacokinetics
What the body does to drugs

- A D M E
  - Absorption
  - Distribution
  - Metabolism
  - Excretion
Drug Absorption – Route

- Oral/Sublingual
- Parenteral
- Topical
- Inhalation
- Optical/Otic
- Rectal/Vaginal
- Intraperitoneal
Absorption Factors

- Drug associated factors
  - Molecular weight
  - Solubility
  - Dosage form

- Patient associated factors (Oral)
  - Gastric content - *Binders*
  - Fluid present
  - GI Motility

- Bioavailability
First Pass Effect

• Swallowed drugs go through the liver first!
• Drugs by all other routes do not!
• Dosing considerations

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Distribution Factors

- Membrane permeability
  - Crossing the blood brain barrier

- Plasma protein binding
  - Free drug molecules
  - Dose adjustments?

- Storage site
  - Fat storage
  - Dosing adjustments?
Drug Distribution

BRAIN

HEART

LIVER

CIRCULATION

FAT DEPOTS

MUSCLE
Drug Metabolism

- **Deactivation**
- **Phase I**
  - Enzymes
  - Oxidation
  - Water soluble
- **Phase II**
  - Conjugation
  - Prep for excretion
- **Activation**
Drug Excretion

- Kidney
  - Glomerular filtration
  - Tubular secretion
  - Passive diffusion
- Intestines
  - Non-absorbed drugs
  - Bile
- Lungs, Skin, Breast milk

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Pharmacodynamics

• What a drug does to the body

• Drug dosing
  • Goal = deliver a optimal therapeutic dose
  • Dosing challenges:
    - Too low ➔ little/no effect
    - Too high ➔ toxicity
How drugs affect cells

- Lock (Receptor) & Key (Ligand)
- Ligands
  - Endogenous
  - Exogenous
How drugs affect cells

Drugs (exogenous ligands)

- Agonists
- Antagonists

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Additional drug affects on cells

Ion Channel Blockers

Enzymes

drug with similarities in shape to substrate binds to active site on enzyme and blocks its activity
Additional drug affects on cells

Carrier molecules

(re-uptake transporter (carrier protein))

neuron terminal

neurotransmitters in vesicle

enzyme removing neurotransmitter

receptors

ion channels

Na^+

post-synaptic membrane
Pharmacokinetics and Pharmacodynamics
Agenda

• Drugs in the Body
• Drug dosing considerations
• Medication Related Problems
• Food/Supplement Interactions
Patient Dosing Factors

GENOTYPE
- CYP2D6 genes
- NAT genes
- ethnic variation

PHYSIOLOGY
- age
- gender
- pregnancy
- heart health
- immune system
- liver function
- kidney function
- GI function

LIFESTYLE
- diet
- supplements & herbs
- smoking
- alcohol intake
- exercise
- stress

ENVIRONMENT
- daily/seasonal rhythms
- occupational exposure
- other medications
- infection
- disease
Drug Dosing Guidelines

- Lower dose / increase dosing interval
  - Absence of kidney function
  - Age + Comorbidities
  - Loading doses

- Common drugs requiring adjustments:
  - Antihypertensives
  - Hypoglycemics
  - Antibiotics
  - NSAIDs and other analgesics

- Is drug dialyzed?
  - HD vs. PD
  - Utilize reference sources
Drug Dosing Guidelines

Excellent References:

• “Drug Prescribing in Renal Failure – Dosing Guidelines for Adults and Children”  Amazon $50

• “Renal Dosing Database” – GlobalRPh
  Free website!
  http://www.globalrph.com/index_renal.htm

• “2013 Dialysis of Drugs”  Available free!
Agenda

• Drugs in the Body
• Drug dosing considerations
• Medication Related Problems
• Food/Supplement Interactions
Polypharmacy

- Highest number of pills
- Multiple co-morbidities
- Multiple doctors
- Multiple pharmacies

Medication Related Problems

✓ Duplicate drugs
✓ Adverse reactions / interactions
✓ Overdosage
✓ Contraindicated drugs
✓ Medication Adherence
Adverse Reactions / Interactions

• Side effects
• Allergic reactions
• Interactions
  ▪ Drug-drug (not just Rx drugs!)
  ▪ Drug-food
  ▪ Drug-diseases
ESRD Contraindicated Drugs

Top 10 to Avoid:

- Metformin
- Sucralfate
- Nitrofurantoin
- Fenofibrate
- Baclofen
- Mag. Citrate
- Ketorolac
- Indomethacin
- Gemfibrozil
- Triam/HCTZ

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Agenda

• Drugs in the Body
• Drug dosing considerations
• Medication Related Problems
• Food/Supplement Interactions
Drug – Food Interactions

- Alcohol
- Grapefruit juice
- Green leafy vegetables
- Licorice
- Chocolate
- Salt substitutes
Drug – Supplement Interactions

- St. John’s Wort
- Garlic
- Vitamin E
- Ginseng
- Ginkgo Biloba
- Aloe Vera
Good Dietitian References

- Globalrph website
  - Drugs to take with/without food
  - Drug – Grapefruit interactions
- “Food/Drug and Drug/Nutrient Interactions”
  University of Florida Extension, May 2009

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Food that Interacts</th>
<th>Effect of the Food</th>
<th>What to Do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesic</td>
<td>Alcohols</td>
<td>Increases risk for liver toxicity</td>
<td>Avoid alcohols</td>
</tr>
<tr>
<td>退烧制剂 (Tylenol)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Antibiotic</td>
<td></td>
<td></td>
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<tr>
<td>tetracyclines</td>
<td>Dairy products, iron supplements</td>
<td>Decreases drug absorption</td>
<td>Take 1 hour before or 2 hours after food/milk</td>
</tr>
<tr>
<td>amoxicillin, penicillin, ciprofloxacin</td>
<td>Food</td>
<td>Decreases drug absorption</td>
<td>Take 1 hour before or 2 hours after milk</td>
</tr>
<tr>
<td>niacinamide (Niacin)</td>
<td>Food</td>
<td>Decreases drug absorption</td>
<td>Take 1 hour before or 2 hours after meals</td>
</tr>
<tr>
<td>Anticoagulant</td>
<td>Foods rich in Vitamin K</td>
<td>Decreases drug effectiveness</td>
<td>Limit foods high in Vitamin K: liver, broccoli, spinach, kale, cauliflower, and Brussels sprouts</td>
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<tr>
<td>warfarin (Coumadin)</td>
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Medication Management - a BIG challenge!
Key Takeaways

- Individual patient responses to drugs are influenced by numerous factors.
- ESRD patient drug therapy requires much attention to avoid MRP’s.
- Food and supplement interactions with drugs need to be monitored.
Questions
References

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