

SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES



UNIT 1

COURSE NAME: PHARMACOLOGY

TOPIC: ADME

CASE STUDY PUZZLE 1: The Overdosed Coffee Addict

Topic: Absorption & First-Pass Effect

Scenario: A 19-year-old student takes **30 tablets of 200 mg caffeine** (total 6,000 mg) to stay awake. He usually drinks coffee (oral caffeine).

- Onset of tremors: **15 minutes**
- Peak plasma [caffeine]: **80 µg/mL** at 1 hour
- Normal coffee peak: **6 µg/mL** after 200 mg

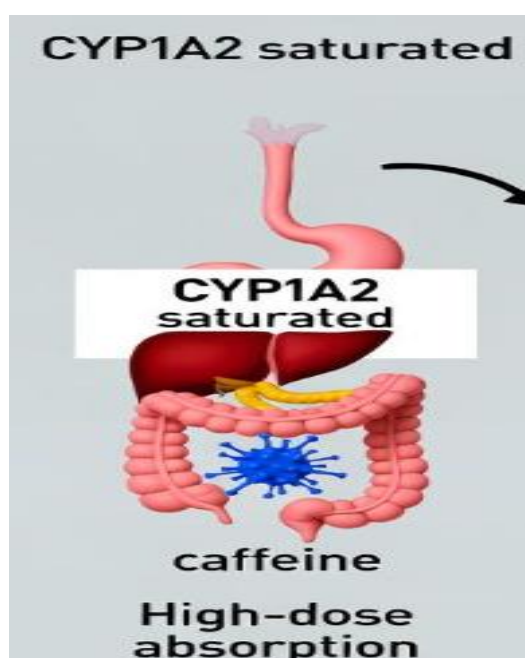
Puzzle Questions:

1. Why such a **rapid onset** despite oral route?
2. Estimate **bioavailability (F)** of oral caffeine.
3. What organ is **saturated**?

Answer Key:

1. **High dose** → **saturates first-pass metabolism** in liver → ↑ systemic absorption.
2.
$$F = \frac{AUC_{oral}}{AUC_{IV}} \approx \frac{80 \times \text{dose}_{\text{coffee}}}{6 \times 6000} = 0.13 \text{ or } 13\%$$

(Typical F for caffeine = ~100%, but **saturated**).
3. **CYP1A2 enzyme in liver** → nonlinear kinetics.



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CASE STUDY PUZZLE 2: The Vanishing Antibiotic

Topic: Volume of Distribution (Vd)

Scenario: A 70 kg septic patient receives 1 g IV vancomycin.

- Plasma [vanco] at 1 hr: **20 µg/mL**
- Expected peak: **30–40 µg/mL**
- Patient is **edematous** (40 L total body water).

Puzzle Questions:

1. Calculate Vd.
2. Why is concentration **lower than expected**?
3. Adjust dose for next time?

Answer Key: 1.

$$V_d = \frac{\text{Dose}}{C_0} = \frac{1000 \text{ mg}}{20 \text{ mg/L}} = 50 \text{ L}$$

(Normal Vd = 0.7 L/kg × 70 = 49 L → **normal**, but **edema** ↑ TBW → **dilutes**). 2. **Third-spacing** in sepsis → ↑ Vd → ↓ plasma []. 3. **Increase loading dose** to 1.5–2 g.



CASE STUDY PUZZLE 3: The Prodrug That Wasn't

Topic: Metabolism (Prodrug Activation)

Scenario: A 55-year-old man with herpes is prescribed **valacyclovir 1 g TID**.

- Day 3: No improvement
- Plasma [acyclovir]: **<0.5 µg/mL** (target >3 µg/mL)
- Genetic test: **CYP2C19 poor metabolizer**

Puzzle Questions:

1. What type of drug is valacyclovir?
2. Why is acyclovir level **low**?
3. Alternative drug?

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Answer Key:

1. **Prodrug** (valacyclovir → acyclovir via **hepatic esterase**, not CYP).
2. **Poor absorption or esterase deficiency** (not CYP2C19). Likely **malabsorption**.
3. Use **IV acyclovir** (active drug).



CASE STUDY PUZZLE 4: The Toddler's Tea Party

Topic: Clearance & Half-Life

Scenario: A 3-year-old (15 kg) accidentally drinks 50 mL of cough syrup (dextromethorphan 15 mg/5 mL = 150 mg).

- $t_{1/2}$ in adults: **4 hours**
- Child is drowsy at **12 hours post-ingestion**
- Plasma [DXM]: **80 ng/mL** (toxic >50 ng/mL)

Puzzle Questions:

1. Estimate $t_{1/2}$ in child.
2. Calculate **clearance (Cl)** if $V_d = 6$ L/kg.
3. When will [DXM] < 25 ng/mL?

Answer Key: 1.

$$t_{1/2} \approx 12 \text{ hr (prolonged due to immature CYP2D6)}$$

$$2. \quad Cl = \frac{\ln(2) \cdot V_d}{t_{1/2}} = \frac{0.693 \cdot (6 \cdot 15)}{12} = 5.2 \text{ L/hr}$$

$$3. \quad t = \frac{\ln(80/25)}{0.693/12} \approx 36 \text{ hr}$$

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CASE STUDY PUZZLE 5: The Dialysis Surprise

Topic: Excretion & Dialyzability

Scenario: A 60-year-old on hemodialysis takes **metoprolol 100 mg BID**.

- Pre-dialysis [metoprolol]: **400 ng/mL**
- Post-dialysis (4 hr): **380 ng/mL**
- Dialyzer: high-flux, blood flow 350 mL/min

Puzzle Questions:

1. Is metoprolol **dialyzable**?
2. Estimate **extraction ratio**.
3. Better beta-blocker for dialysis patient?

Answer Key:

1. **No** — highly protein-bound (95%), large Vd.
2. $ER = \frac{400-380}{400} = 5\%$ (negligible)
3. **Atenolol** or **carvedilol** (less protein binding).

