Drug Therapy In Pediatric & Geriatric Age Groups

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Objectives

a. Discuss the principles of prescribing in pediatric and geriatric age groups.

b. Discuss the pharmacokinetic and pharmacodynamics differences in pediatric, geriatric and adult age groups.

c. Describe how the efficacies of drugs vary according to age.

d. Describe different paediatric dosage forms & compliance in children.

e. Discuss important adverse drug reactions occurring in geriatric & pediatric age groups.

What is different from normal adult prescribing?

Children cannot be regarded as miniature adults in terms of drug response, due to differences in body constitution, drug

absorption and elimination, and sensitivity to adverse reactions.

Pediatric Group – Pharmacokinetics

Absorption:

o Gastro-intestinal absorption is slower in infancy, but absorption from intra-muscular injection is faster.

o Infant skin is thin and percutaneous absorption can cause systemic toxicity

Distribution:

o Lower volume of distribution of fat-soluble drugs (e.g. **diazepam**) in infants.

o Plasma protein binding of drugs is reduced in neonates.

o Blood–brain barrier is more permeable in neonates and young children, leading to an increased risk of CNS adverse effects.

Metabolism:

o At birth, the hepatic microsomal enzyme system is relatively immature.

o Drugs administered to the mother can induce neonatal enzyme activity (e.g. barbiturates).

Excretion:

o All renal mechanisms (filtration, secretion and reabsorption) are reduced in neonates.

o Subsequently, during toddlerhood, it exceeds adult values, often necessitating larger doses per kilogram. E.g. the dose per kilogram of digoxin is much higher in toddlers than in adults

PHARMACODYNAMICS

- Apparently paradoxical effects of some drugs (e.g. hyperkinesia with **phenobarbitone**, sedation of hyperactive children with **amphetamine**) are as yet unexplained.
- Augmented responses to **warfarin** in prepubertal patients occur at similar plasma concentrations as in adults, implying a pharmacodynamic mechanism.

PEDIATRIC DRUG DOSAGE

- Most drugs approved for use in children have recommended pediatric doses, generally stated as milligrams per kilogram.
- Calculations of pediatric dosage:
    - **Surface area based (Young's formula): Dose** = $Adult$

$$Dose \times \frac{Age(years)}{(Age+12)}$$

- o Body weight based (Clark's rule):
  Dose = $Adult\ Dose \times \frac{Weight\ (kg)}{70}$

ADVERSE EFFECTS

- With a few notable exceptions, drugs in children generally have a similar adverse effect profile to those in adults.

Some specific ADR examples are;

- chronic corticosteroid use, including high-dose inhaled corticosteroids, to inhibit growth
- Tetracyclines are deposited in growing bone and teeth, causing staining and occasionally dental hypoplasia
- Fluoroquinolone antibacterial drugs may damage growing cartilage

- Dystonias with metoclopramide occur more frequently in children and young adults than in older adults
- Valproate hepatotoxicity is increased in young children

PEDIATRIC DOSAGE FORMS & COMPLIANCE

- Children under the age of five years may have difficulty in swallowing even small tablets, and hence oral preparations which taste pleasant are often necessary to improve compliance. (Elixirs & Suspensions)
- Pressurized aerosols (e.g. **salbutamol** inhaler) in children over the age of ten years, as coordinated deep inspiration is required. Nebulizers may be used.
- Children find intravenous infusions uncomfortable and restrictive. Rectal administration is a convenient alternative (e.g. **metronidazole** to treat anaerobic infections). Rectal **diazepam** is particularly valuable in the treatment of status epilepticus. Rectal

administration should also be considered if the child is vomiting.

Rules of prescribing for Pediatric populations

- Calculate the doses for prescribed drugs based on weight of the patients.
- Ensure proper instructions to the care giver, including when the child vomits the given medication after consumption.
- Ensure that all medicines are strictly out of reach of children at all times.
- Avoid prolonged treatment with drugs that have delayed complications (Steroids).
- Use antibiotics sparingly and only when required.

- Medications affecting the CNS need to be extensively reviewed and routinely monitored to ensure minimal growth disturbances.

Geraitric Group - Pharmacokinetics

- **Absorption:** Little evidence of any major alteration in drug absorption with age. However, conditions associated with age may alter rate at which some drugs are absorbed. (Diabetic gastroparaesis, laxative abuse)
- **Distribution:** Elderly have reduced lean body mass, reduced body water.
- **Metabolism:** Capacity of liver to metabolize drugs does not appear to decline consistently with age for all drugs.
- **Elimination:** Kidney is major organ for clearance of drugs from body, age-related decline of renal functional capacity is important.

Pharmacodynamics

- Geriatric patients believed to be much more "sensitive" to action of many drugs, implying a change in pharmacodynamic interaction of drugs with their receptors. BUT, most of these are a result of changing Pharmacokinetics!

Rules of prescribing for the elderly

o Think about the necessity for drugs.
o Avoid drugs with negligible or doubtful benefits.
o Think about the dose.
o Think about drug formulation.
o Assume any new symptoms may be due to drug side-effects.

o Take a careful drug history.
o Use fixed combinations of drugs rarely.
o Check Compliance.
o Think before adding a new drug to the regimen.
o Stopping is as important as Starting.

Geriatric Prescribing - ADRs

ADRs and Age

o Incidence of ADR increases with age

o   Elderly receive more medicines

o   Incidence of ADR increases the more prescribed medicines taken

o For patients aged>50 yrs

> o ADR rates – 5% for 1 or 2 medicines
> o Increased to 20% when >5 medicines

Most frequent drug classes causing ADRs

o Cardiovascular active agents

o Analgesics (opioid mainly)

o Antibiotics

o Hypoglycemic agents

o Psychotropic agents

o Anticoagulants

THANK YOU