Clinical Pharmacology & Biopharmaceutics

Editorial Open Access

Pharmacokinetic Variability in Pediatric and Geriatric Populations: Challenges and Solutions

Dalia M. Ghorab*

Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Cairo University, Egypt

Keywords: Pharmacokinetics; Pediatric populations; Geriatric populations; Drug absorption; Drug metabolism; Drug distribution; Drug elimination; Age-related changes; Drug interactions; Clinical pharmacology; Pharmacokinetic variability; Dosing regimens; Therapeutic drug monitoring; Adverse drug reactions; Age-dependent metabolism; Polypharmacy.

Introduction

Pharmacokinetic variability—the way the body absorbs, distributes, metabolizes, and eliminates drugs—differs significantly across different age groups, particularly in pediatric and geriatric populations. Children and elderly individuals represent special groups in clinical pharmacology due to the physiological and metabolic changes that occur with age. In pediatric populations, organ systems are still developing, while in geriatric populations, aging often leads to declines in organ function, which can affect drug kinetics and response. This variability can pose challenges in ensuring effective and safe medication use. The challenge lies in determining the appropriate dosing regimens that are both effective and safe for these age groups. This paper explores the pharmacokinetic variability in pediatric and geriatric populations, identifies the challenges that arise, and discusses potential solutions to improve drug therapy in these populations [1-4].

Description

Pharmacokinetics involves the study of drug absorption, distribution, metabolism, and elimination (ADME) within the body. These processes are influenced by factors such as age, genetic factors, and health conditions, making it critical to tailor medication regimens to specific populations [5,6].

In pediatric populations, pharmacokinetic variability is driven by the immature development of organs like the liver, kidneys, and gastrointestinal (GI) tract. Drug absorption in neonates and infants can be slower or more erratic due to differences in GI tract motility and enzyme activity. Drug metabolism is also immature at birth, which can lead to slower clearance and altered half-lives. As children grow, their metabolic pathways mature, but variations persist based on developmental stage, weight, and organ maturation [7,8].

In contrast, geriatric populations often experience declines in organ function, including reduced renal clearance and hepatic metabolism. Aging can lead to polypharmacy, as elderly individuals are often prescribed multiple medications for concurrent health conditions, increasing the risk of drug-drug interactions and adverse effects. Age-related changes in body composition, such as a decrease in lean body mass and an increase in body fat, can also alter the distribution of drugs, affecting their efficacy and toxicity [9,10].

Discussion

Pharmacokinetic Variability in Pediatric Populations: Pediatric pharmacokinetics is influenced by the developmental changes in drug absorption, distribution, metabolism, and elimination that occur from infancy to adolescence. Absorption rates can be slower in neonates and infants due to delayed gastric emptying and altered gastric pH. The maturation of intestinal enzymes and gut motility also affects drug absorption, making dose adjustment crucial in early childhood.

Drug distribution is affected by changes in body water, fat composition, and plasma protein levels in children. Newborns and infants have a higher proportion of body water and lower levels of plasma proteins like albumin, affecting the free fraction of drugs in circulation. This can lead to differences in drug pharmacokinetics, requiring pediatric-specific dosing regimens based on weight or body surface area (BSA).

Metabolism in children is immature at birth, with phase I and phase II liver enzymes not fully functional. As the child matures, enzyme activity increases, but this development is gradual. For example, the cytochrome P450 enzymes (CYP450) responsible for drug metabolism undergo changes during early childhood, leading to different drug metabolism rates. Inadequate enzyme function in neonates or infants may result in prolonged drug half-lives and accumulation, raising the risk of toxicity if dosed inappropriately.

Renal function also develops postnatally, with immature kidney function in neonates contributing to slower drug clearance, which must be accounted for in pediatric dosing.

Pharmacokinetic Variability in Geriatric Populations: In elderly patients, pharmacokinetic changes are mainly driven by aging-related physiological changes, such as decreased renal clearance, reduced hepatic blood flow, and changes in body composition. Aging leads to renal decline, as the glomerular filtration rate (GFR) and renal tubular secretion decrease, which can cause drugs to accumulate in the body if dosed based on normal renal function.

Conclusion

Pharmacokinetic variability in pediatric and geriatric populations presents unique challenges in drug discovery, prescribing, and therapy. Age-related physiological changes affect drug absorption, distribution, metabolism, and elimination, which may necessitate different dosing strategies. Pediatric patients require careful consideration of developmental changes, including organ immaturity and growth-related changes, while geriatric patients face the challenges of declining

***Corresponding author:** Dalia M. Ghorab, Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Cairo University, Egypt, E-mail: daliaghorab34@gmail.com

Received: 03-Feb-2024, Manuscript No: cpb-25-164301, **Editor Assigned:** 07-Feb-2024, pre QC No: cpb-25-164301 (PQ), **Reviewed:** 18-Feb-2024, QC No: cpb-25-164301, **Revised:** 24-Feb-2024, Manuscript No: cpb-25-164301 (R), **Published:** 28-Feb-2024, DOI: 10.4172/2167-065X.1000547

Citation: Ghorab DM (2025) Pharmacokinetic Variability in Pediatric and Geriatric Populations: Challenges and Solutions Clin Pharmacol Biopharm, 14: 547.

organ function, polypharmacy, and altered body composition.

References

1. Epstein RS, MoyerTP , AubertRE (2010) Warfarin genotyping reduces hospitalization rates results from the MM-WES (Medco-Mayo Warfarin Effectiveness study) J Am Coll Cardiol 55: 2804–2812
2. Zhang X, Jiang S, Xue J (2022) Personalized antiplatelet therapy guided by clopidogrel pharmacogenomics in acute ischemic stroke and transient ischemic attack: a prospective, randomized controlled trial. Front Pharmacol 13: 931405
3. Swen JJ, vander Wouden CH , Manson LE (2023) A 12-gene pharmacogenetic panel to prevent adverse drug reactions: an open-label, multicentre, controlled, cluster-randomised crossover implementation study. Lancet 401: 347-356
4. Morris SA, Alsaidi AT, VerbylaA (2022) Cost effectiveness of pharmacogenetic testing for drugs with Clinical Pharmacogenetics Implementation Consortium (CPIC) guidelines: a systematic review. Clin Pharmacol Ther 112: 1318-1328
5. Nagy M, Lynch M, Kama S (2020) Assessment of healthcare professionals' knowledge, attitudes, and perceived challenges of clinical pharmacogenetic testing in Egypt. PernMed 17: 251-260
6. Rodrigues T, Reker D, Schneider P, Schneider G (2016) Counting on natural products for drug design. Nat Chem 8: 531
7. Siddiqui AA, Iram F, Siddiqui S, Sahu K (2014) Role of natural products in drug discovery process. Int J Drug Dev Res 6:172-204.
8. Watkins R, Wu L, Zhang C, Davis RM, Xu B (2015) Natural product-based nanomedicine: recent advances and issues. Int J Nanomed 10: 6055.
9. Jahangirian H, Lemraski EG, Webster TJ, Rafiee-Moghaddam R, Abdollahi Y (2017) A review of drug delivery systems based on nanotechnology and green chemistry: green nanomedicine. Int J Nanomed 12: 2957.
10. Swamy MK, Sinniah UR (2016) Patchouli (Pogostemon cablin Benth.): botany, agrotechnology and biotechnological aspects. Ind Crops Prod 87: 161-176