WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Time-Release Revolution-Precision with Chrono Therapeutics

V.Swathi[1], Dr.M.Swetha[2]

[1] Student, Department of Pharmaceutics, Sarojini Naidu Vanita pharmacy Maha Vidyalaya, Affiliated to Osmania University.

[2] Associate Professor, Department of Pharmaceutics, Sarojini Naidu Vanita pharmacy Maha Vidyalaya, Affiliated to Osmania University

ABSTRACT

Chrono formulation drug delivery system is a time-controlled approach for optimal therapeutic efficiency. It is an advanced approach in pharmaceutical technology, aiming to optimize therapeutic outcomes by synchronizing drug release with the body's physiological events. This review provides an overview of chrono formulation types, Chrono pharmacokinetics, Chronopharmacodynamic, Applications and benefits of chrono formulations and challenges in chrono formulation developments. Applications of chrono formulation system extend across a wide range of therapeutic areas, including cardiovascular diseases, neurological disorders, and cancer, demonstrating their versatility and potential impact on clinical practice. This comprehensive review underscores the importance of chrono formulation drug delivery systems in advancing pharmacotherapy towards tailored and efficacious treatments tailored to individual patient's needs.

INTRODUCTION [1-2]

Chrono formulation is a specialized field in pharmaceutical science that focuses on developing drug delivery systems capable of releasing medication at specific times or according to circadian rhythms. These formulations are designed to optimize therapeutic outcomes by synchronizing drug release with the body's natural biological rhythms, which can influence factors such as drug absorption, metabolism, and distribution, it is to understanding that the body's physiological processes, including the sleep-wake cycle, hormone production, and other vital functions, follow a 24-hour rhythm known as the circadian rhythm. By aligning drug delivery with these rhythms, chrono formulations aim to enhance the efficacy and safety of medications.

Chrono formulations can take various forms, including controlled-release tablets, capsules, patches, and implants. They are designed to release the drug either immediately, after a specified delay, or in a pulsatile manner to match the desired dosing schedule. This approach can be particularly beneficial for medications that exhibit time-dependent efficacy or that have side effects that vary with time.

Benefits of Chrono formulations: [1,3]

Enhanced Therapeutic Efficacy: By releasing drugs at the optimal times, chrono formulations can improve drug effectiveness and therapeutic outcomes. For example, a drug that needs to be active during the night can be released in a sustained manner during the evening.

Reduced Side Effects: Chrono formulations can minimize side effects by delivering drugs when they are most needed and avoiding excessive drug concentrations during other times.

Optimized Drug Delivery: These formulations can provide a more consistent drug concentration in the blood, leading to more predictable and controlled drug delivery.

Tailored Treatment: Chrono formulations can be tailored to match the individual's circadian rhythm, providing personalized treatment regimens.

Classification based on Mechanism of Chrono formulation[3&4]

It refers to a drug formulation that is designed to release the active pharmaceutical ingredient (API) in a time-controlled manner, often to achieve a specific pharmacokinetic profile or therapeutic effect. The mechanism of chrono formulation varies depending on the specific technology or approach used. Some common mechanisms:

Coating: The drug is coated with a polymer that dissolves or erodes at a controlled rate, releasing the drug gradually over time. This can be achieved through various coating techniques such as film coating or microencapsulation.

Matrix Systems: The drug is dispersed or embedded in a matrix of a polymer or other excipients that control the release rate. The matrix can be

designed to degrade or swell slowly, releasing the drug over an extended period.

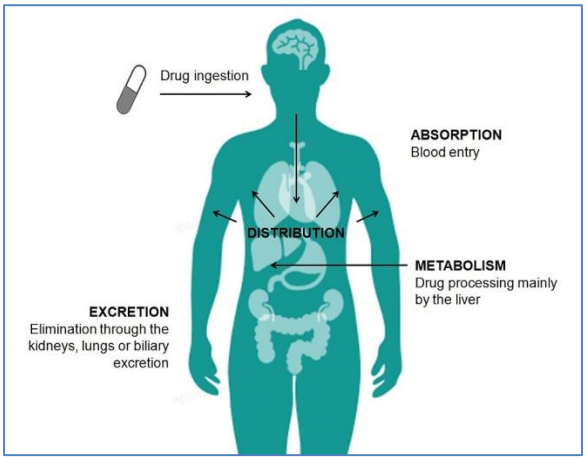
Osmotic Pump Systems: These systems use osmotic pressure to deliver the drug at a controlled rate. The drug is contained within a semi-permeable membrane that allows water to enter and push the drug out through a small orifice.

Ion Exchange Resins: The drug is complexed with ion exchange resins that release the drug in response to changes in pH or ionic strength in the gastrointestinal tract.

Multiple Unit Systems: In this approach, the drug is formulated into multiple units (e.g., pellets, beads) that are coated or embedded in a matrix. This allows for more precise control over the release rate and duration.

Chrono pharmacokinetics [5]

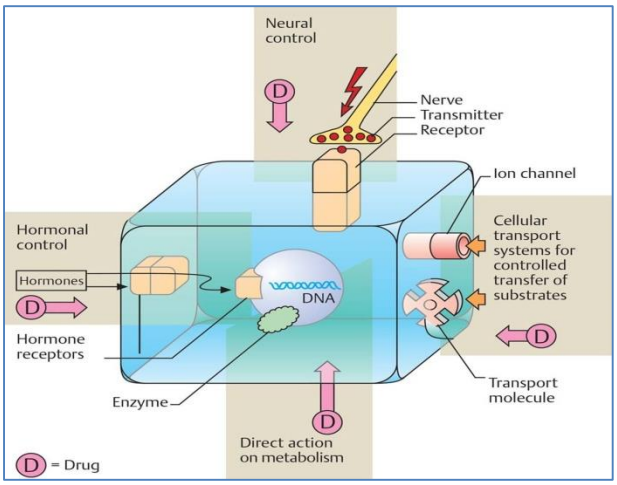
Chronopharmacokinetics studies how the body's absorption, distribution, metabolism, and excretion of drugs vary over a 24-hour period. Factors such as gastrointestinal motility, enzyme activity, and renal function can influence drug pharmacokinetics throughout the day. Understanding these rhythms is essential for developing chrono formulations that align drug delivery with the body's natural rhythms.



Chrono pharmacodynamics [5-6]

Chronopharmacodynamics examines how the body's response to drugs changes over the course of a day.

Receptor sensitivity, enzyme activity, and cell signaling pathways can fluctuate based on circadian rhythms, affecting drug efficacy and toxicity. By targeting drug release to specific times, chrono formulations can optimize therapeutic effects and minimize side effects.



Types of Chrono formulations [5-6]

Delayed-release formulations are designed to release the drug after a specific period, such as enteric-coated tablets that resist dissolution in the stomach.
Pulsatile-release formulations release the drug in bursts at predetermined intervals to mimic natural physiological rhythms.
Controlled-release formulations maintain steady drug levels over an extended period, reducing the need for frequent dosing.

Challenges of chrono formulation development[6-8]

Complexity: Designing chrono formulations requires a thorough understanding of drug properties, circadian rhythms, and formulation technologies.
Regulatory considerations: Chrono formulations may require additional testing and regulatory approval due to their unique release profiles.
Manufacturing challenges: Producing chrono formulations with precise release kinetics can be technically challenging and may require specialized equipment.

Applications of Chrono formulations [7-8]

Asthma: Chrono inhalers can deliver bronchodilators when airway constriction is most severe, improving symptom control.
Hypertension: Chrono formulations of antihypertensive drugs can target blood pressure spikes during the morning hours, reducing cardiovascular risk.
Arthritis: Chrono formulations of anti-inflammatory drugs can be timed to coincide with peak joint pain and stiffness, providing sustained relief.
Marketed products of Chrono formulations
Concerta: This is a popular extended-release formulation of methylphenidate used to treat attention deficit hyperactivity disorder (ADHD). It utilizes an osmotic-controlled release oral delivery system (OROS) to deliver the drug over an extended period, providing symptom control throughout the day.
Protonix: This is a delayed-release formulation of pantoprazole, a proton pump inhibitor used to treat conditions such as gastroesophageal reflux disease (GERD). It uses an enteric coating to protect the drug from stomach acid and deliver it to the small intestine where it is absorbed.
OxyContin: This is an extended-release formulation of oxycodone, a potent opioid analgesic. It uses a controlled-release delivery system to provide pain relief for up to 12 hours per dose.
Diltiazem CD: This is an extended-release formulation of diltiazem, a calcium channel blocker used to treat hypertension and angina. It uses a matrix-based delivery system to provide sustained release of the drug over 24 hours.
Glucophage XR: This is an extended-release formulation of metformin, an oral antidiabetic medication. It uses a dual hydrophilic polymer matrix system to control the release of the drug, allowing for once-daily dosing.

REFERENCES:

1. Medical, L. (2023, March 21). Overview of pharmacokinetics: Four stages in a drug traveling within the body. Laxxon Medical. https://www.laxxonmedical.com/post/what-is-pharmacokinetics-four-stages-in-a-drug-traveling-within-the-body
2. Mehta, K. S., Srivastava, S., Kumar, D., Jha, A. K., Mohanta, S. C., Panda, S. K., Gat, G. V., & Ltd, J. G. (2016, October 6). US20190099408A1 - Delayed release pharmaceutical composition of pantoprazole and process for formulation thereof - Google Patents. https://patents.google.com/patent/US20190099408A1/en
3. Santus, G., & Baker, R. W. (1995). Osmotic drug delivery: a review of the patent literature. Journal of Controlled Release, 35(1), 1–21. https://doi.org/10.1016/0168-3659(95)00013-x
4. Finn, K., Moore, D., Dailey, Y., & Thompson, W. (2023). The use of oral benzodiazepines for the management of dental anxiety: a web-based survey of UK dentists. British Dental Journal. https://doi.org/10.1038/s41415-023-5850-5
5. Mechanisms of Drug Action and Pharmacodynamics - Pharmacology - An Illustrated review. (n.d.). https://doctorlib.info/pharmacology/illustrated/2.html\
6. Singh, R., Sharma, P., Malviya, R., & Highway, D. (2010). Review on chronotherapeutics - a new remedy in the treatment of various diseases. https://www.semanticscholar.org/paper/Review-on-Chronotherapeutics-A-New-Remedy-in-the-of-Singh-Sharma/67040d4040f6002c7d9d3508bcaaea4f742a53fb
7. Smolensky, M. H., Lemmer, B., & Reinberg, A. E. (2007). Chronobiology and chronotherapy of allergic rhinitis and bronchial asthma. Advanced Drug Delivery Reviews, 59(9–10), 852–882. https://doi.org/10.1016/j.addr.2007.08.016
8. Reddy, A. B., & O'Neill, J. S. (2010). Healthy clocks, healthy body, healthy mind. Trends in Cell Biology, 20(1), 36–44. https://doi.org/10.1016/j.tcb.2009.10.005