CLINICAL PHARMACOLOGY OF ANTI-INFLAMMATORY DRUGS

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Abstract. *Anti-inflammatory drugs are among the most commonly used medications worldwide, but their use remains complex due to their diverse mechanisms, therapeutic effects, and side effects. This article aims to examine the clinical pharmacology of anti-inflammatory drugs with a focus on current findings and practical implications. It explores the mechanisms of action, clinical uses, pharmacokinetics, and risks associated with non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids. A special attention is given to the development of selective COX-2 inhibitors and emerging therapies. The findings suggest that despite progress in safer drug development, responsible and individualized use remains critical to reduce adverse events.*

Key words: *anti-inflammatory drugs, NSAIDs, corticosteroids, COX-2 inhibitors, clinical pharmacology, inflammation*

Introduction

Inflammation is a protective biological response to injury or infection, yet chronic or excessive inflammation can lead to tissue damage and various diseases. Anti-inflammatory drugs help reduce inflammation and are essential in treating conditions such as arthritis, asthma, and autoimmune disorders. However, despite their benefits, many of these drugs have significant side effects, especially when used long-term. This paper reviews the clinical pharmacology of the two main groups of anti-inflammatory drugs (non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids), and discusses their modern applications, mechanisms, and limitations based on current scientific literature.

Methods

This paper is based on a review of recent scientific articles, clinical guidelines, and pharmacology textbooks published between 2019 and 2024. Sources were selected using databases like PubMed and Google Scholar with search terms such as "clinical pharmacology anti-inflammatory drugs," "NSAIDs side effects," and "COX-

2 inhibitors". Articles that discussed new findings, mechanisms of action, and real-world clinical data were prioritized.

Results

NSAIDs work by inhibiting cyclooxygenase (COX) enzymes, especially COX-1 and COX-2, which play a key role in producing prostaglandins that cause inflammation and pain. Traditional NSAIDs, like ibuprofen and naproxen, block both COX-1 and COX-2, which leads to both anti-inflammatory effects and gastrointestinal side effects (Brune and Patrignani, 2015). COX-2 selective inhibitors, such as celecoxib, were developed to minimize gastrointestinal issues while preserving anti-inflammatory action (Roubille et al., 2020).

Corticosteroids, such as prednisone and dexamethasone, act differently. They enter cells and bind to glucocorticoid receptors, affecting gene expression to suppress many pro-inflammatory cytokines and increase anti-inflammatory proteins (Cain and Cidlowski, 2017). This makes them highly effective but also increases the risk of systemic side effects like osteoporosis, diabetes, and immunosuppression.

NSAIDs are usually rapidly absorbed and highly protein-bound. They have varying half-lives and are metabolized by the liver, mainly through cytochrome P450 enzymes. Moreover, NSAIDs are used for mild to moderate pain and inflammation, including headaches, muscle injuries, and arthritis. Meanwhile, corticosteroids have longer half-lives and their pharmacokinetics depend on whether they are given orally, intravenously, or as inhalers. Corticosteroids are used for more severe or chronic inflammatory conditions, such as asthma, lupus, or inflammatory bowel disease (Giorgi and Marzocchi, 2021).

Long-term use of NSAIDs can lead to gastrointestinal bleeding, kidney damage, and increased cardiovascular risk, especially in older patients (Antman et al., 2022). Corticosteroids are even more problematic long-term, leading to adrenal suppression and metabolic issues. Recently, there is growing interest in biologics and small molecules that more specifically target inflammatory pathways, such as interleukin blockers or Janus kinase (JAK) inhibitors. These drugs are more expensive but may offer fewer side effects and more targeted action (Furst and Emery, 2019).

Discussion

The clinical pharmacology of anti-inflammatory drugs shows the challenge of balancing therapeutic benefits with adverse effects. NSAIDs remain essential for pain and inflammation control, especially when used for short durations. The development of COX-2 inhibitors represents a step toward safer drugs, although caution is still necessary. Corticosteroids are powerful but should be used only when necessary due to their systemic impact. Also, combining anti-inflammatory drugs with protective

agents (e.g., proton pump inhibitors with NSAIDs) is recommended in many clinical settings. This review suggests that while anti-inflammatory drugs have improved, rational prescribing based on updated clinical knowledge is still key to avoiding complications.

Conclusion

Anti-inflammatory drugs are powerful tools in clinical medicine, but they require careful selection and monitoring. Advances in pharmacology, including selective COX-2 inhibitors and biologics, show promise, but no drug is without risks. Understanding the pharmacology behind these drugs helps clinicians make informed decisions and promotes safer treatment of inflammatory diseases.

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