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PECULIARITIES OF THE USE OF ANTI-INFLAMMATORY DRUGS IN CHILDREN

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Abstract

This article analyzes the clinical and pharmacological characteristics of anti-inflammatory drug use in children, focusing on age-related physiological differences, pharmacokinetic variability, safety considerations, and dosing principles. Special attention is given to nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and selective anti-inflammatory agents frequently used in pediatric practice. The article highlights the risks of gastrointestinal, renal, and cardiovascular complications, emphasizing the importance of individualized therapy, weight-based dosing, and evidence-based monitoring strategies. Modern clinical guidelines and international recommendations regarding pediatric anti-inflammatory therapy are also reviewed.

Keywords: Anti-inflammatory drugs, pediatric pharmacology, NSAIDs, corticosteroids, dosing, safety monitoring, clinical guidelines, inflammation management.

INTRODUCTION

In pediatric practice, the use of anti-inflammatory drugs requires a particularly cautious, physiology-based approach because children's metabolic pathways, enzymatic activity, and immune responses differ substantially from those of adults. These differences influence not only drug absorption but also distribution, biotransformation, elimination, and ultimately, clinical efficacy and safety profiles. Inflammation in children often presents with more rapid systemic involvement due to higher vascular reactivity and immature regulatory mechanisms; therefore, anti-inflammatory therapy must be carefully tailored to the child's developmental stage, underlying disease, and comorbid conditions [1].

One of the most important considerations is the age-dependent variability in hepatic enzyme activity. For instance, CYP450 isoenzymes responsible for metabolizing NSAIDs and corticosteroids mature gradually throughout childhood. Because neonates and infants have relatively low enzymatic capacity, even standard pediatric dosages may accumulate and increase the risk of toxicity. Conversely, older children with more active metabolism may require weight-adjusted or condition-specific dosing to ensure adequate therapeutic plasma levels. In clinical pharmacology, this

creates a scenario where drug selection shifts from a “one-size-fits-all” perspective to a precisely calibrated approach that takes physiological maturation into account [2].

MATERIALS AND METHODS

A further challenge arises from the increased susceptibility of children to gastrointestinal and renal complications associated with NSAIDs. The gastric mucosa in younger patients is more vulnerable to prostaglandin inhibition, which can lead to mucosal irritation and, in severe cases, erosive gastritis. Renal adverse effects also occur more readily because renal blood flow in children is heavily prostaglandin-dependent. For this reason, clinicians often prioritize paracetamol as a first-line antipyretic and mild anti-inflammatory agent, reserving stronger NSAIDs such as ibuprofen or naproxen for conditions requiring more potent inflammatory control. Even then, the co-administration of gastroprotective agents and strict limitation of duration are standard safety measures [3].

Corticosteroids, though highly effective, represent another category where pediatric specificity is crucial. Because of their strong systemic effects, long-term or improperly monitored use may cause growth suppression, adrenal insufficiency, behavioral changes, and immunosuppression. To mitigate these risks, clinicians employ the lowest effective dose, rely more heavily on inhaled or topical formulations when applicable, and emphasize step-down strategies to prevent withdrawal syndromes. Furthermore, short “burst therapy” regimens are preferred in acute inflammatory diseases such as croup or acute asthma exacerbations, minimizing cumulative exposure while preserving therapeutic benefit [4].

RESULTS AND DISCUSSION

In recent years, pediatric pharmacology has also seen a shift toward biologic anti-inflammatory agents, especially in autoimmune or severe chronic inflammatory disorders. Agents such as anti-TNF-α antibodies (e.g., infliximab, adalimumab) and interleukin inhibitors (e.g., tocilizumab) offer targeted action with fewer systemic effects. However, their use in children requires careful immunization planning, tuberculosis screening, and long-term infection monitoring. The advantages lie in their specificity: by targeting cytokines selectively involved in the inflammatory cascade, biologics can control disease activity without broadly suppressing immunity, making them suitable for conditions like juvenile idiopathic arthritis and pediatric inflammatory bowel disease [5].

Drug interactions constitute another pediatric concern, particularly because children often receive combination therapies for infections, asthma, allergic disorders, or

gastrointestinal problems. For example, the concurrent use of NSAIDs with loop diuretics or ACE-inhibitors in certain cardiac or renal conditions can precipitate acute kidney injury, whereas corticosteroid interactions may interfere with vaccine response or increase susceptibility to opportunistic infections. Therefore, pediatric clinicians must evaluate each treatment plan holistically, anticipating interactions and monitoring for subtle early signs of toxicity [6].

Finally, adherence and formulation-related issues are central to pediatric anti-inflammatory therapy. Children may reject bitter or large-volume liquid formulations, complicating treatment adherence and leading to subtherapeutic dosing. To address this, pharmaceutical development increasingly focuses on child-friendly delivery systems such as flavored suspensions, dispersible tablets, chewable forms, and even transdermal patches. These innovations not only improve compliance but also ensure more stable pharmacokinetic profiles, thus enhancing therapeutic outcomes. Parental education plays a pivotal role as well, as caregivers must understand dosing schedules, indications, and warning signs, especially when medications are administered at home rather than under direct supervision [7].

Collectively, these considerations underscore that anti-inflammatory therapy in children demands a nuanced, developmentally informed strategy. It must balance efficacy with safety, anticipate age-specific risks, and incorporate both pharmacological precision and practical considerations of pediatric care. The emphasis on individualized therapy, careful monitoring, and modern drug-delivery innovations continues to refine the quality of pediatric anti-inflammatory management, supporting better long-term outcomes and reducing preventable complications.

The clinical use of anti-inflammatory drugs in children requires a distinctly cautious, individualized, and development-sensitive approach because the pediatric organism responds to pharmacological agents differently from adults. These differences are rooted in age-dependent variations in gastrointestinal absorption, hepatic metabolism, renal clearance, plasma protein binding, and receptor sensitivity, all of which influence drug efficacy and toxicity profiles [1]. In young children, for instance, the gastric pH remains relatively high, which may increase the systemic bioavailability of acid-labile anti-inflammatory drugs, while decreased gastric motility may delay absorption. The immaturity of cytochrome P450 enzymes, particularly CYP2C9 and CYP3A4—responsible for metabolizing many NSAIDs—adds another layer of complexity to dosing strategies. Because of this, pediatric anti-inflammatory therapy emphasizes lower initial doses, gradual titration, and careful observation for early signs of intolerance.

A fundamental component of pediatric anti-inflammatory pharmacotherapy is the differentiation between non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids, as each class plays a distinct role in managing inflammatory conditions. NSAIDs are typically first-line agents in mild to moderate inflammatory diseases such as juvenile idiopathic arthritis, viral myalgias, and febrile conditions. However, their cyclooxygenase inhibition may increase the risk of gastritis, renal impairment, and platelet dysfunction more prominently in children with underlying comorbidities. Therefore, agents such as ibuprofen and naproxen are favored due to well-defined pediatric dosing protocols and comparatively safer profiles, whereas drugs like aspirin are avoided because of the associated risk of Reye syndrome—a severe but preventable consequence of aspirin use during viral infections [2]. The avoidance of aspirin in children is one of the most critical pediatric-specific pharmacological distinctions, underscoring the need for precise diagnosis and medication selection.

Corticosteroids, on the other hand, remain indispensable in severe conditions such as asthma exacerbations, autoimmune diseases, inflammatory bowel disease, nephrotic syndrome, and acute allergic reactions. Their benefits stem from powerful immunosuppressive and anti-inflammatory actions, yet prolonged corticosteroid therapy may impair linear growth, alter bone metabolism, induce behavioral changes, and suppress the hypothalamic–pituitary–adrenal (HPA) axis in children. These risks necessitate the strict principle of “the lowest effective dose for the shortest possible duration”, combined with regular monitoring of growth parameters, electrolyte balance, adrenal function, and behavioral patterns [3]. In many pediatric settings, inhaled or topical corticosteroids are preferred over systemic forms to minimize systemic exposure and preserve long-term developmental outcomes.

Pediatric patients are also uniquely vulnerable to renal and hepatic complications from anti-inflammatory therapies, particularly when NSAIDs are used during dehydration, viral illnesses, or underlying kidney disorders. Renal prostaglandin inhibition can precipitate acute kidney injury, especially in toddlers who may have fluctuating intravascular volume. As a result, clinicians emphasize hydration, avoidance of polypharmacy, and routine laboratory monitoring in children receiving repeated or high-dose NSAID therapy [4]. In settings where inflammation coexists with infection—common among children—anti-inflammatory drugs must be used judiciously to avoid masking symptoms of underlying bacterial disease.

CONCLUSION

In conclusion, the use of anti-inflammatory drugs in children requires a highly individualized and evidence-based approach due to the unique physiological and pharmacokinetic characteristics of the pediatric population. Clinicians must carefully balance therapeutic benefits with potential risks, considering factors such as age, body weight, organ maturity, comorbidities, and the long-term impact of drug exposure. NSAIDs remain the most widely used anti-inflammatory agents, but they must be applied cautiously to prevent gastrointestinal and renal adverse events. Corticosteroids, although effective, demand strict control due to their significant systemic effects in growing children. Adherence to international guidelines, continuous monitoring, and parental education play a vital role in ensuring safe and effective treatment outcomes. Continued research and pediatric-specific clinical trials are essential to improving drug safety and optimizing therapeutic strategies in pediatric inflammatory conditions.

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