Adverse Effects of Topical Corticosteroid Usage in Children: A Review

Nathan Francis

Abstract

This review explores the long-term effects of topical corticosteroid (TCS) use in children with atopic dermatitis, focusing on adverse outcomes associated with treatment lasting longer than one year. While TCS are the first-line therapy for managing eczema flares due to their powerful anti-inflammatory properties, their prolonged use in pediatric populations has raised concerns about both local effects (such as skin atrophy and perioral dermatitis) and systemic risks, including effects like hypothalamic-pituitary-adrenal axis suppression and growth delay (Fisher, 1995; Stacey & McEleney, 2021). This review outlines the pharmacological mechanisms of TCS, current best practice treatment regimens, and age-specific considerations in pediatric care. Clinical data suggest intermittent or proactive use of low to moderate potency TCS can be safe in the short term, but evidence for long-term safety remains limited and inconsistent (Harvey et al., 2023; Kamiya et al., 2022). This gap in research may complicate decision-making for clinicians and caregivers, namely when balancing disease control against potential harms. By reviewing findings from clinical trials and review papers, this paper aims to inform safer, more effective treatment strategies for children requiring long-term eczema management.

Introduction

Atopic dermatitis (also called eczema) affects approximately 72.4 million children globally and can persist into adolescence and adulthood (Jin et al., 2024). Topical corticosteroids remain the cornerstone for managing acute flares due to their proven anti-inflammatory properties (Siegfried et al., 2016). However, apprehension regarding their safety profile, particularly fears of adverse effects like skin atrophy and skin growth suppression, has led to underuse or inconsistent application by caregivers (Lee et al., 2015). In response, various strategies have been recommended to limit steroid use while maintaining disease control (Axon et al., 2021). These strategies include reducing application frequency to once daily during flare treatment, or using TCS intermittently, such as two consecutive days per week, as a maintenance approach to prevent relapses (Axon et al., 2021). Despite these efforts, much of the available evidence on TCS safety comes from short-term studies, typically lasting only a few weeks, which limits current understanding of adverse effects that may take longer to develop (Axon et al., 2021). This review aims to investigate the adverse side effects children experience from using topical corticosteroids for more than one year to treat eczema. It seeks to clarify the long-term safety profile of TCS in pediatric populations

Literature Review

Pediatric Atopic Dermatitis

Atopic dermatitis is a chronic, inflammatory skin condition that affects approximately 15–30% of children worldwide, most commonly beginning in infancy or early childhood (Mori et al., 2022). Clinically, it presents with intense pruritus (itching), dry skin, and skin lesions that often involve the cheeks, scalp, or extensor limbs in infants, and flexural areas (areas where the skin naturally folds) in older children (Mori et al., 2022). The disease typically follows a relapsing–remitting course and may be exacerbated by triggers such as allergens, infection, or seasonal changes (Mori et al., 2022). In addition to chronic inflammation, atopic dermatitis is associated with epidermal barrier dysfunction, leading to increased transepidermal water loss and susceptibility to secondary infections (Mori et al., 2022). Although many children experience improvement with age, up to 50% continue to have persistent or recurrent symptoms into adolescence or adulthood (Mori et al., 2022).

Mechanism of Action of Topical Corticosteroids

The mechanism of action of topical corticosteroids involves preventing inflammatory responses through methods such as vasoconstriction, inhibiting phospholipase A2 release, and (Ahluwalia, 1998). Vasoconstriction is the process of narrowing blood vessels, which reduces the amount of inflammatory mediators that are delivered to a certain region, in this case, the upper dermis (Ahluwalia, 1998). Inhibition of phospholipase A2 release is achieved by producing lipocartin, a protein that slows down both inflammation and skin cell growth (Ahluwalia, 1998). This subsequently reduces the production of prostaglandins and leukotrienes (King, 2020). Prostaglandins are local lipid mediators that promote inflammation, pain, fever, and vasodilation (King, 2020). Leukotrienes are eicosanoid mediators produced by leukocytes that drive immune cell recruitment, vascular leakage, and smooth-muscle contraction (King, 2020). Corticosteroids

inhibit inflammatory transcription factors by binding to glucocorticoid receptors and recruiting histone deacetylase-2 (HDAC2) to suppress NF-κB and AP-1–driven genes, which normally increase inflammation (Ahluwalia, 1998).

In some cases, the corticosteroid-receptor complex can work without binding to DNA by interacting with other proteins in the cytoplasm (Coondoo et al., 2016). As these drugs also reduce cell growth in the skin by increasing lipocartin, they prove especially helpful in dermatological conditions like eczema and psoriasis (Coondoo et al., 2016). In deeper layers of the skin, corticosteroids reduce the activity of cells like fibroblasts, which helps limit scarring and skin thickening (Coondoo et al., 2016). They also weaken the immune system's response by stopping immune cells from maturing and multiplying (Coondoo et al., 2016). In addition, they reduce the release of substances like cytokines that normally boost inflammation (Coondoo et al., 2016). Altogether, these effects make topical corticosteroids useful for treating many skin diseases that involve inflammation and overactive immune responses (Coondoo et al., 2016).

Recommended Usage Timeline for Topical Corticosteroids

Topical corticosteroids are used in a multitude of strategies for treating dermatological conditions such as eczema, with varying degrees of effectiveness (Frantz et al, 2019). For children experiencing an atopic dermatitis flare, standard initial treatment typically involves once- or twice-daily application of a medium- to high-potency corticosteroid for up to four weeks, depending on disease severity and location (Frantz et al., 2019). If sufficient improvement is observed during this period, treatment can either be tapered in potency or frequency or discontinued entirely (Frantz et al., 2019). Clinical evidence also supports the notion that once-daily application is likely as effective as twice-daily use, even for medium or high potency corticosteroids during active flares, which can simplify regimens and improve adherence in pediatric populations, though twice-daily use may still be used based on misinformation (Lax et al., 2022). If a child does not respond adequately to a high-potency corticosteroid within four weeks, treatment may be escalated to a super-high potency corticosteroid for up to two weeks, followed by a taper or switch to a lower potency agent for maintenance (Frantz et al., 2019).z

For maintenance therapy, proactive or intermittent strategies have shown clinical value in pediatric patients (Kamiya et al., 2022). Proactive therapy refers to the application of a high-potency corticosteroid twice weekly to previously affected areas after remission (Kamiya et al., 2022). In one 2019 to 2022 pediatric study involving 52 patients with eczema, patients maintained on proactive therapy had a relapse rate of 8.3% compared to 12.0% among those transitioned to daily lower-potency corticosteroids (Kamiya et al., 2022). This finding suggests better itch control and potentially improved long-term disease suppression with proactive therapy (Kamiya et al., 2022). Notably, the incidence of adverse events in this study was low with both strategies, and no significant changes were seen in cortisol or ACTH levels (which suggests the treatment didn't interfere with the body's natural hormone balance), supporting their safety in children over short durations (Kamiya et al., 2022).

Proactive therapy has been associated with a lower risk of relapse compared to reactive or "rank-down" approaches (Kamiya et al., 2022). Notably, strategies such as wet wrap (moisturizing the affected area, then applying a damp cloth) therapies have shown mixed results in terms of both efficacy and safety, with evidence suggesting that improper use may increase the risk of adverse effects or infection, particularly in younger children (Frantz et al., 2019). According to a 2019 study by Feldman et al., factors such as a child's age, body surface area

involved, and site of application must be carefully considered when determining treatment duration and potency, as pediatric skin absorbs corticosteroids more readily than adult skin.

Side Effects of Topical Corticosteroid Use in Children

Dermatological side effects

Topical corticosteroids, while highly effective in managing inflammatory skin conditions in children, are associated with a range of local and systemic adverse effects, particularly when used inappropriately, at high potency, or for prolonged periods of over six weeks or longer (Fisher, 1995; Stacey & McEleney, 2021). Among pediatric patients, a commonly reported local side effect includes skin atrophy, which arises from corticosteroid-induced inhibition of fibroblast activity and reduced collagen synthesis (Stacey & McEleney, 2021). Clinically, this appears as thinning of the skin, increased skin fragility, and the development of telangiectasias and purpura, especially in areas of chronic application such as the face, axillae, or groin (Fisher, 1995; Stacey & McEleney, 2021). Striae distensae, or stretch marks, are also a notable side effect in children and can develop quickly, even with medium-potency corticosteroids used for as little as one to two weeks (Fisher, 1995).

Of note, facial application of TCS in pediatric patients carries a higher risk of inducing perioral dermatitis, acneiform eruptions, and steroid-induced rosacea (Fisher, 1995). These reactions are believed to stem from rebound vasodilation and microbial proliferation, particularly of Demodex folliculorum mites and Propionibacterium acnes bacteria, following abrupt corticosteroid withdrawal (Fisher, 1995). In some pediatric cases, inflammatory rebound is significant enough to require systemic antibiotic treatment, such as tetracycline or erythromycin, although antibiotic use in children must be carefully considered, given that an imbalance in treatment may cause severe health problems and eventual antibiotic resistance (Fisher, 1995; Stacey & McEleney, 2021).

Topical corticosteroids can also impair the skin's local immune response, reducing its ability to fight off infection (Fisher, 1995). This immunosuppression can mask or exacerbate fungal infections such as dermatophytosis, resulting in tinea incognito (an atypical clinical presentation of a common fungal infection made more severe by corticosteroid use) (Fisher, 1995). Furthermore, corticosteroid therapy may facilitate secondary bacterial or Candida yeast infections in the skin due to compromised local immunity (Stacey & McEleney, 2021).

In rare cases, children may develop allergic contact dermatitis in response to a corticosteroid molecule itself or to typical excipients (a vehicle substance for another drug) found in topical formulations, such as lanolin, parabens, or quaternium-15 (Fisher, 1995). These reactions usually present as chronic, erythematous, and papular eruptions, and they can be misinterpreted as worsening of the primary dermatologic condition (Fisher, 1995). Differentiating allergic reactions to TCS from irritant dermatitis or hypersensitivity to other ingredients in the drug's vehicle is critical (Stacey & McEleney, 2021).

Systemic side effects

Children are particularly vulnerable to systemic side effects of topical corticosteroids because of their relatively larger body surface area in relation to body weight, which increases their percutaneous absorption of this medication (Fisher, 1995). Systemic adverse effects in pediatric patients may include suppression of the hypothalamic-pituitary-adrenal axis, growth retardation,

Cushing's syndrome, hyperglycemia, and hypertension (Stacey & McEleney, 2021). Even relatively low doses of high-potency corticosteroids can cause significant systemic absorption in children, particularly when applied to thin-skinned areas like the eyelids, groin, or diaper region, or when occlusion (such as with diapers) is present (Fisher, 1995). In addition, ocular complications such as cataracts and glaucoma, though rare, have been reported in children following prolonged corticosteroid use near the eyes (Stacey & McEleney, 2021).

Long-term topical corticosteroid use in children

Although low-potency corticosteroids are generally better tolerated in pediatric populations, long-term treatment should be approached with caution (Stacey & McEleney, 2021). Close monitoring is essential when topical corticosteroids are used in children, especially in infants or toddlers, due to their enhanced skin permeability and systemic susceptibility (Stacey & McEleney, 2021). Careful selection of the appropriate potency, duration, and application site is necessary to avoid complications (Stacey & McEleney, 2021). There is no strong evidence supporting the development of tachyphylaxis, or diminished therapeutic response, with continued corticosteroid use in children (Stacey & McEleney, 2021). However, corticosteroid withdrawal—sometimes referred to as topical steroid addiction—can occur after extended use, particularly on the face or genital regions (Stacey & McEleney, 2021). This corticosteroid withdrawal is characterized by erythema, burning, stinging, papules, and pustules following sudden discontinuation and represents rebound inflammation rather than loss of drug efficacy (Stacey & McEleney, 2021).

Discussion

The long-term use of topical corticosteroids in pediatric patients with eczema presents a nuanced clinical picture. While TCS remains the gold standard for controlling inflammatory flares due to its potent anti-inflammatory and immunosuppressive mechanisms, extended use raises valid concerns about both local and systemic adverse effects in children (Siegfried et al, 2016).

Long-term TCS use, especially high-potency agents applied to large body surface areas or thin-skinned regions, has been linked to hypothalamic-pituitary-adrenal (HPA) axis suppression, growth retardation, and, in severe cases, Cushingoid features (Fisher, 1995). These potential adverse effects carry serious implications, particularly in pediatric populations (Fisher, 1995). HPA axis suppression and growth retardation may interfere with a child's normal physical development, while Cushingoid features can cause both physiological and psychological distress (Fisher, 1995). This raises an important clinical question: are these risks more detrimental than the condition being treated? In cases of severe eczema, where the disease significantly affects quality of life, sleep, and school attendance, the benefits of effective treatment may outweigh the risks (Harvey et al, 2023). A 2023 systematic review by Harvey et al. provides reassurance that intermittent use of low- to moderate-potency TCS over long periods (up to 5 years) appears to carry minimal risk of growth abnormalities, skin atrophy, or adrenal insufficiency. Thus, in severe or poorly controlled cases, the disease burden of eczema may well surpass the relatively low risk of long-term TCS treatment (Fisher, 1995). However, for milder cases, the potential harm of long-term TCS use may not justify aggressive treatment, especially given evidence that many adverse outcomes remain uncertain or understudied (Fisher, 1995). Although studies have shown that once-daily or intermittent application regimens can mitigate these risks, these findings often stem from trials lasting only a few weeks to a few

months (Fisher, 1995). Evidence regarding the persistence or cumulative impact of these effects beyond one year remains limited and inconclusive. As Harvey et al. highlights, many knowledge gaps remain, particularly for mid-to-high potency regimens and outcomes beyond 5 years . This scarcity of high-quality long-term data may stem from ethical constraints in prolonged pediatric trials, challenges with funding and participant retention, heterogeneity of TCS formulations, and inconsistency in reporting adverse effects (Harvey et al, 2023). As a result, clinicians may make long-term treatment decisions in the absence of definitive data, underscoring the need for caution and individualized care plans.

Importantly, recent studies on proactive TCS strategies, such as twice-weekly application to previously affected areas, have demonstrated reduced relapse rates and a favorable short-term safety profile, with no significant alterations in cortisol or ACTH levels (a hormone that releases cortisol) (Kamiya et al., 2022). However, these findings cannot yet be confidently extrapolated to extended use over several years, given that no long-term safety profile has been created. Pediatric endocrinologic monitoring is rarely incorporated into long-term dermatologic studies, and subclinical suppression of adrenal function may go undetected without targeted testing (Stacey & McEleney, 2021). There is limited empirical support for the development of tachyphylaxis in children, however, prolonged use does appear to be associated with rebound flares upon abrupt cessation, particularly in sensitive areas (Stacey & McEleney, 2021). This "topical steroid withdrawal syndrome" or "steroid addiction" has been reported as distressing for both patients and caregivers and can lead to mistrust in medical guidance, contributing to TCS underuse or non-adherence (Lee et al, 2015). Despite these risks, it is essential to acknowledge that poorly controlled eczema also carries significant burdens, such as chronic itching, and increased susceptibility to infections (Boguniewicz and Leung, 2010; Langan et al, 2017). Therefore, the decision to continue TCS treatment beyond one year for maintenance must balance potential long-term adverse effects against the morbidity of uncontrolled disease (Boguniewicz and Leung, 2010; Langan et al, 2017). Clinical judgment, individualized treatment plans, and regular monitoring are vital to optimizing both safety and efficacy.

Conclusion

Topical corticosteroids are indispensable in the management of pediatric eczema, offering rapid and effective control of inflammation. However, long-term use beyond one year, especially when involving high-potency agents or sensitive application sites, increases the risk of both local and systemic side effects in children. While proactive and intermittent TCS regimens appear to reduce relapse rates and minimize some risks, current evidence is largely based on short-term studies and does not adequately address long-term safety concerns.

Given children's heightened vulnerability to adverse effects due to their thinner skin and greater body surface area-to-weight ratio, a cautious and tailored approach to long-term TCS use is warranted. Strategies might include avoiding continuous application to high-risk areas, incorporating regular treatment breaks, and considering non-steroidal alternatives when appropriate. Further longitudinal studies are urgently needed to better understand the cumulative impact of TCS over multiple years and to develop evidence-based guidelines for extended use in pediatric populations.

Ultimately, improving caregiver education and providing consistent follow-up may enhance adherence, reduce misuse, and ensure that the therapeutic benefits of TCS are realized without compromising long-term safety.

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