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Review Article

Emerging Treatment for Contact Dermatitis: A Review of Novel Therapies

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ABSTRACT

Contact dermatitis is an itchy rash caused by direct contact with a substance or an allergic reaction to it. The rash isn't contagious, but it can be very uncomfortable. Many substances can cause this reaction, such as cosmetics, fragrances, and plants. The rash often shows up within days of exposure. To treat contact dermatitis successfully, you need to identify and avoid the cause of your reaction. Symptoms of contact dermatitis can include itchy or dry skin, a red rash, bumps, blisters, or swelling. These rashes are not contagious or life-threatening, but can be very uncomfortable. Consumer products and topical medications today contain many allergens that can cause a reaction on the skin known as allergic contact dermatitis. This review looks at various allergens in these products and reports current allergic contact dermatitis incidence and trends in North America, Europe, and Asia. First, medication contact allergy to corticosteroids will be discussed along with its five structural classes (A, B, C, D1, D2) and their steroid test compounds (tixocortol-21-pivalate, triamcinolone acetonide, budesonide, clobetasol-17-propionate, hydrocortisone-17-butyrate). Finally, we examine the ingredients in the excipients of these products, such as the formaldehyde releasers (quaternium-15, 2-bromo-2-nitropropane-1,3 diol, diazolidinyl urea, imidazolidinyl urea, DMDM hydantoin), the non-formaldehyde releasers (isothiazolinones, parabens, methyl dibromoglutaronitrile, iodopropynyl butylcarbamate, and thimerosal), fragrance mixes, and Myroxylon pereirae (Balsam of Peru) for contact allergy incidence and prevalence. Contact dermatitis is divided into irritant contact dermatitis and allergic contact dermatitis. This causes your body to release inflammatory chemicals that can make your skin feel itchy and irritated. Immunological responses are due to the interaction of cytokines and T cells. This activity reviews the causes, pathophysiology, and diagnosis of contact dermatitis.

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INTRODUCTION

Contact dermatitis (CD) is a common inflammatory skin disease caused by exposure to contact allergens and irritants. It is also the most common reason of occupational dermatitis and contributes greatly to hand dermatitis and facial dermatitis. Besides the two major forms of contact dermatitis: allergic contact dermatitis and irritant contact dermatitis, other subtypes of CD have been recognized including immediate skin reactions, photoinduced contact dermatitis, systemic contact dermatitis, and non-eczematous contact dermatitis. Contact dermatitis usually leads to erythema and scaling with visible borders [1]. For the diagnosis of CD, a complete medical history, including occupational history, is very important. It can give a clue of CD and provide a list of suspected substances. Besides the well-known diagnostic test, patch testing, there are many other diagnostic tests can be used to help diagnosis of CD and identify the causative allergens, including photo patch test, skin tests for detecting of immediate contact reactions, serum allergen-specific IgE test, and qualitative and quantitative testing of allergen in the suspected materials patients exposed to and challenge test [2,3] Itching and discomfort may also occur. Acute cases may involve a dramatic flare with erythema, vesicles, and chronic cases may involve lichen with cracks and fissures. CD is an itchy rash caused by direct contact with a substance or an allergic reaction to it. The rash isn't contagious, but it can be very uncomfortable. To treat contact dermatitis successfully, you need to identify and avoid the cause of your reaction. If you avoid the substance causing the reaction, the rash often clears up in 2 to 4 weeks. [4] In addition, it is also important to restore the skin barrier and reduce skin inflammation through multiple treatments, such as emollients, topical corticosteroids, and antihistamines, as well as systemic corticosteroids.

Causes

Contact dermatitis is caused by exposure to a substance that irritates your skin or triggers an allergic reaction. The substance could be one of thousands of known allergens and irritants. Often people have irritant and allergic reactions at the same time.

➤ Irritant contact dermatitis

Irritant contact dermatitis is the most common type. This nonallergic skin reaction occurs when an irritant damages your skin's outer protective layer. Some rashes look like an allergic reaction but aren't, because your immune system wasn't involved. [5,6] Instead, you touched something that removed the surface oils shielding your skin. The longer it stayed on your skin, the worse the reaction. Some people react to strong irritants after a single exposure. Others may develop a rash after repeated exposures to even mild irritants, such as soap and water. [7,8] And some people develop a tolerance to the substance over time. When something is irritating or damaging your skin, you'll probably see a rash right away. With an allergy, it may be a day or two before the rash shows up.

Common Irritants Include:

- Solvents
- Rubber gloves
- Bleach
- Hair products
- Soap or detergents.
- Plants
- Fertilizers
- Pesticides
- Antiseptics.
- Antibacterials.

➤ Allergic contact dermatitis



Allergic contact dermatitis is an inflammatory disease of the skin that is caused by a type 4 hypersensitivity reaction. It results from the contact of an offending chemical or antigen with the skin, and the subsequent T-cell mediated response. [9] Allergic contact dermatitis occurs when a substance to which you're sensitive (allergen) triggers an immune reaction in your skin. It often affects only the area that came into contact with the allergen[10,11]. But it may be triggered by something that enters your body through foods, flavorings, medicine, or medical procedure.

Common Allergens Include:

- Metals, such as nickel.
- Perfumes or chemicals in cosmetics.
- Balsam of Peru, which is in some foods and skin care products.
- Skin care products with fragrances.
- Topical Medication including antibiotics.
- Preservatives or chemicals.
- Rubber materials, latex gloves.
- Household Cleaners and Disinfectants.
- Poison ivy, poison oak and poison sumac.
- Citrus fruit, especially the peel.
- Fragrances in soaps, shampoos and lotions.
- Perfumes, and Cosmetics.
- Airborne allergens, such as ragweed pollen and spray insecticides.
- Personal care products, such as body washes, hair dyes and cosmetics.

Diagnosis

Diagnosing contact dermatitis (CD) involves identifying the cause of the skin reaction and distinguishing it from other skin conditions like eczema or fungal infections. Your health care provider may be able to diagnose contact dermatitis by talking to you about your signs and symptoms. [12,13,14] You might be asked

questions to help identify the cause of your condition and uncover clues about the trigger substance. And you'll likely undergo a skin exam to assess the rash. Your health care provider may suggest a patch test to identify the cause of your rash. In this test, small amounts of potential allergens are put on sticky patches. Then the patches are placed on your skin. [15] They stay on your skin for 2 to 3 days. During this time, you'll need to keep your back dry. Then your health care provider checks for skin reactions under the patches and determines whether further testing is needed. This test can be useful if the cause of your rash isn't apparent or if your rash recurs often. [16,17] But the redness indicating a reaction can be hard to see on brown or Black skin, which may lead to a missed diagnosis. Medical History recent exposure to potential irritants/allergens (e.g., soaps, metals, plants). [18] Work & hobbies (e.g., exposure to chemicals, gloves, cosmetics) Previous skin conditions (e.g., eczema, psoriasis). Physical Examination Symptoms observed: Redness, itching, swelling Blisters or dry, cracked skin Pattern of rash (localized vs. widespread) Affected areas (e.g., hands, face, neck). Patch Testing (For Allergic Contact Dermatitis). [19] Used to identify allergens (e.g., nickel, latex, fragrances) Procedure: Small amounts of allergens are applied to the skin using adhesive patches → Checked after 48-72 hours for reactions. Skin Biopsy (Rare Cases) Performed if the rash does not improve or if another condition is suspected. [20] Helps rule out psoriasis, fungal infections, or autoimmune diseases. Elimination Testing The patient avoids suspected triggers for a period to see if symptoms improve. Common for irritant contact dermatitis where patch testing is not useful.[21]

Precautions

Preventing contact dermatitis (CD) involves avoiding triggers, protecting the skin, and



maintaining proper skincare. The precautions differ based on whether the condition is irritant contact dermatitis (ICD) or allergic contact dermatitis (ACD).

Avoiding Triggers (Primary Prevention):

Identify and eliminate irritants/allergens (cosmetics, soaps, lotions). Be cautious with latex gloves (use nitrile instead). [21,22] Avoid rubber chemicals (found in shoes, adhesives)

For Irritant Contact Dermatitis (ICD):

Avoid harsh soaps, detergents, and alcohol-based sanitizers. Protect hands from solvents, acids, alkalis, and cleaning agents. Avoid excessive water exposure (e.g., prolonged handwashing).[23] Read Labels Carefully. Check for hypoallergenic, fragrance-free, and dye-free products. Avoid formaldehyde, parabens, and methylisothiazolinone in skincare items.[24]

Protective Measures (Barrier Protection): Wear Protective Gloves

Use nitrile or vinyl gloves instead of latex. For prolonged water exposure, use cotton gloves inside rubber gloves. Protective Clothing Wear long sleeves and protective gear when handling chemicals.[25] Avoid tight clothing that may trap allergens. Use Barrier Creams & Moisturizers Apply petrolatum-based moisturizers to create a protective layer. [26,27] Use barrier creams like dimethicone-based lotions before exposure to irritants.

Skin Care Routine (Maintaining Skin Health):

Gentle Cleansing Use mild, fragrance-free soap (e.g., Cetaphil, Dove Sensitive). Avoid antibacterial or deodorant soaps (can strip natural oils). Pat skin dry gently instead of rubbing. Regular Moisturizing. Apply thick, fragrance-free emollients (e.g., Vaseline, CeraVe, Eucerin).

Moisturize immediately after washing to lock in moisture. Use ointments or creams (better than lotions) for dry skin.

Environmental & Lifestyle Changes: Avoid Extreme Temperatures Cold weather dries out skin Use a humidifier. Hot showers worsen dryness Use lukewarm water.] **Minimize Hand Washing & Water Exposure** Use hand sanitizers with moisturizers instead of frequent washing. Wear rubber gloves when doing dishes or cleaning. [28] **Reduce Sweat & Friction** Sweat can worsen irritation—wear breathable fabrics (cotton over synthetics). Rinse off immediately after exercise or sweating. **Preventing Flare-ups & Secondary Infections** Avoid Scratching Scratching worsens inflammation and can lead to infection. Keep nails short and clean. Use cold compresses to soothe itching. **Manage Stress & Allergies** Stress can worsen allergic reactions Try relaxation techniques . If you have seasonal allergies, take antihistamines to prevent flare-ups.[29]

Treatment

Treatment for contact dermatitis (CD) focuses on relieving symptoms, managing inflammation, and precluding unborn responses. Then's a breakdown of common treatment approaches. Treatment often begins by avoiding or removing the trigger as well as using an at-home skin care regimen. [30] You may also require other medications prescribed by your doctor. Its also important to try and figure out the cause of the reaction and avoid contact with the irritant or allergen that triggers your dermatitis. Doing so allows your skin to heal and prevent future flare-ups. A doctor can help identify the cause if it's unclear. Home remedies and medical treatments that may help with contact dermatitis. [31]

❖ **Corticosteroids:** Corticosteroids play a major role in the treatment of many dermatologic



conditions. They are FDA-approved and indicated for the use of inflammatory and pruritic presentations of dermatologic conditions. The well-known indications are for diseases such as psoriasis, limited areas of vitiligo, eczema, atopic dermatitis, phimosis, acute radiation dermatitis, lichen planus, lichen, discoid lupus erythematosus, and lichen sclerosis.[32] They are effective for conditions involving hyper-proliferation, immunological, and inflammatory properties. This activity outlines the indications, mechanism of action, methods of administration, important adverse effects, contraindications, toxicity, and monitoring, of topical corticosteroids so providers can direct patient therapy where they are indicated as part of the interprofessional team. [Hydrocortisone (OTC), or prescription-strength creams like clobetasol for severe cases. Apply a thin layer to the affected area once or twice daily for 1-2 weeks (or as prescribed). [33] Steroid creams, also known as corticosteroid creams, are medicated, water-based formulations containing corticosteroids that are applied to the skin to reduce inflammation, redness, itching, and swelling. They are commonly used in the treatment of contact dermatitis (CD) and other inflammatory skin conditions. These are applied to the Airborne allergens, such as ragweed pollen and spray insecticides skin to help soothe the rash. You might apply prescription topical steroids, such as clobetasol 0.05% or triamcinolone 0.1%. Talk with your health care provider about how many times a day to apply it and for how many weeks. Suitable for moist, oozing, or weeping skin lesions. Absorbs quickly into the skin but may require frequent application. Contains anti-inflammatory properties that suppress the immune response. [34]

❖ **Antihistamines:** Cardizem tablets belong to a group of medicines called calcium channel blockers or calcium antagonists. They work by opening up blood vessels, which lowers blood pressure and lets more blood and oxygen reach the heart. Cardizem CD is designed to release the active ingredient slowly so that it works over 24 hours and can be taken once a day (CD stands for "controlled delivery"). Cardizem tablets release the active ingredient faster and so must be taken more often (3-4 times a day, as your doctor has instructed). They do not change the amount of calcium in your blood or bones. Hydroxyzine It is a first-generation antihistamine that is used to treat severe itching and allergic reactions in contact dermatitis (CD). [35] It is more potent than loratadine and cetirizine but causes significant sedation, making it useful for nighttime itching relief. Stronger itch relief than second-generation antihistamine Sedating effect – Helps patients sleep if itching is severe Reduces swelling & redness by blocking histamine (H1 receptor) Has anti-anxiety effects, which can help reduce stress-related scratching. Loratadine works by blocking histamine (H1 receptors), It is a second-generation antihistamine commonly used to relieve itching, redness, swelling and allergic reactions in contact dermatitis (CD). Cetirizine works by blocking histamine (H1 receptors), a key chemical involved in allergic skin reactions. It is a second-generation antihistamine commonly used to treat itching and inflammation associated with contact dermatitis (CD). Compared to loratadine, cetirizine is slightly stronger but can cause mild sedation in some people. In severe cases, your health care provider may prescribe pills you take by mouth (oral medications) to reduce swelling, relieve itching or fight a bacterial infection.[36]



❖ **Anti-itching cream:** Anti-itching creams are topical formulations designed to relieve pruritus (itching) associated with contact dermatitis (CD). They work by cooling the skin, numbing nerve endings, or reducing inflammation and histamine release. Put on the itchy area 1% hydrocortisone cream or ointment. This is a nonprescription product that you can buy at a drugstore. Use it 1 to 2 times a day for a few days. Or try calamine lotion. Whatever product you use, try cooling it in the refrigerator before applying. This medication is a mild corticosteroid. Wash and dry your hands before using. Clean and dry the affected area. If you are using the lotion or foam, shake it well just before using. If you are using the cream, After applying the medication, wash your hands, unless the hands are being treated. Avoid getting this medication in the eyes, nose, or mouth.[37]

❖ **Moisturizer and lotions:** Moisturizers and lotions for contact dermatitis (CD) are topical formulations designed to hydrate, protect, and repair the skin barrier, reducing inflammation, itching, and irritation caused by allergic or irritant exposures. These products help to restore moisture balance and support skin healing. Moisturizers Thick, occlusive formulations (e.g., creams, ointments) that provide deep hydration and form a protective barrier against irritants. Lotions are typically lighter, water-based formulations compared to moisturizers and are ideal for mild to moderate contact dermatitis or for use in hairy areas like the scalp. Light weight and non-greasy, making them suitable for larger areas of the body. Quick absorption into the skin. Often used for mild cases of CD or as part of maintenance therapy after the initial inflammation is controlled.[38]

Novel Treatments

Novel treatments for contact dermatitis refer to emerging or innovative therapeutic approaches that address the condition in ways that go beyond conventional treatments like corticosteroids, antihistamines, and emollients. Recent advancements in contact dermatitis (CD) treatment focus on targeted therapies, barrier repair, and alternative anti-inflammatory approaches to improve symptom control and reduce side effects associated with traditional treatments like topical corticosteroids. Examples include advanced topical formulations, biologics, small-molecule inhibitors, microbiome-modulating agents, and phototherapy methods.

❖ **Antibodies:** A monoclonal antibody targeting the IL-31 receptor, also underwent clinical trials. In a *post hoc* analysis of a phase 2b trial of moderate-to-severe AD among participants with EASI ≥ 16 at baseline, nemolizumab therapy resulted in improvements in inflammation, pruritus, and sleep. A 24-week, double-blind, multicenter nemolizumab dose-finding study in which participants were randomized to placebo, 10, 30, or 90 mg subcutaneous monthly injections showed similar improvements, with a maximal dose effect at 30 mg.[39] A 16-week, double-blind, phase 3 trial reported that nemolizumab treatment in AD induced a greater reduction in pruritus than placebo plus topical agents. Finally, a meta-analysis of 14 cohorts among 6 randomized, controlled studies of nemolizumab in AD showed “a promising effect based on the difference in the average change in pruritus visual analog score and EASI versus placebo.”[40]

❖ **Barrier-repair therapies:** Barrier-repair therapies focus on restoring and maintaining the skin barrier, which is often compromised in

contact dermatitis (CD). Damage to the skin barrier allows irritants and allergens to penetrate the skin inflammation and symptoms such as redness, itching, and dryness. These therapies aim to repair, strength, and protect the skin to prevent and manage CD. Essential skin lipids like ceramides, cholesterol, and free fatty acids, which are critical for barrier function. **MOA** Barrier-repair therapies supply exogenous lipids such as ceramides, cholesterol, and fatty acids in ratios similar to the skin's natural lipid profile. These lipids integrate into the lipid bilayers of the stratum corneum, enhancing its ability to retain moisture and resist environmental damage. They also promote the reorganization of lamellar bodies, ensuring the correct layering of lipid bilayers.[41]

- ❖ **Reducing Trans epidermal Water Loss (TEWL):** Trans-epidermal water loss (TEWL) refers to the passive evaporation of water from the skin's surface through the epidermis. Increased TEWL is a hallmark of impaired skin barrier function, leading to dehydration, irritation, and increased susceptibility to external aggressors. Therapies aimed at reducing TEWL focus on restoring the barrier function, enhancing hydration, and creating protective layers. Repairing the skin barrier reduces water loss, improving hydration and reducing dryness. The lipid matrix in the stratum corneum (SC) is critical for water retention and acts as a barrier to water loss.[42] **MOA** Lipid-based formulations (containing ceramides, cholesterol, and fatty acids) replenish the lipid matrix, filling gaps between corneocytes. These lipids reorganize into a lamellar structure, mimicking the natural barrier that prevents water from escaping

through the epidermis. Ceramides, in particular, restore the bilayer's integrity, a key determinant of TEWL regulation.[43]

- ❖ **Antioxidants:** Antioxidants have gained attention as potential treatments for contact dermatitis (CD) due to their ability to neutralize oxidative stress, which plays a significant role in the inflammation and skin barrier damage seen in CD. These therapies are used to reduce symptoms, promote skin healing, and improve overall skin health. **MOA:** Neutralization of Reactive Oxygen Species (ROS) Antioxidant scavenge reactive oxygen species (ROS) generated by skin inflammation and environmental irritants, preventing oxidative damage to cells and tissues. **Oxidative Stress in CD:** Allergens or irritants induce the production of ROS, which damages lipids, proteins, and DNA in the skin, exacerbating inflammation[44]. **Antioxidant Function:** Antioxidants act as electron donors to neutralize free radicals (e.g., superoxide, hydroxyl radicals), converting them into stable and non-reactive molecules. By reducing ROS levels, antioxidants prevent the cascade of oxidative damage and inflammation. **Enhancement of Skin Barrier Function** Contact dermatitis often compromises the skin barrier, increasing transepidermal water loss (TEWL) and susceptibility to irritants/allergens. Lipid-soluble antioxidants integrate into the skin's lipid bilayer, stabilizing and restoring the stratum corneum. **Promotion of Cellular Repair** Antioxidants stimulate the repair of damaged cells by Enhancing DNA repair mechanisms. Promoting keratinocyte proliferation and migration to restore the epidermal barrier.[45]
- ❖ **Phototherapy:** Contact dermatitis is an inflammatory skin condition caused by

exposure to irritants or allergens, leading to redness, itching, and swelling. Phototherapy, particularly narrowband UVB (NB-UVB) and psoralen plus UVA (PUVA), is used in severe or chronic cases of contact dermatitis when topical treatments fail. Phototherapy works by modulating immune responses and reducing inflammation in the skin. Types of Phototherapy: Narrowband UVB (NB-UVB, 311–313 nm): Commonly used for inflammatory skin conditions due to its ability to penetrate the epidermis and modulate keratinocyte activity[46]. UVA (320–400 nm): Penetrates deeper into the dermis, affecting fibroblasts and immune cells. PUVA (Psoralen + UVA): Combines a photosensitizing agent (psoralen) with UVA light to enhance therapeutic effects. MOA Immunosuppression UV light modulates the immune response at both the local and systemic levels: T-Cell Inhibition: UV radiation reduces the proliferation and activation of T-cells (especially CD4+ and CD8+ T-cells) involved in the delayed hypersensitivity response characteristic of allergic contact dermatitis. It induces apoptosis in activated T-cells, thereby reducing the number of immune effectors in the skin. Dendritic Cell Modulation: Langerhans cells (a type of dendritic cell in the skin) are depleted or impaired by UV radiation, reducing antigen presentation to T-cells.[47] Reduction of Inflammatory Mediators UV light decreases the expression of adhesion molecules (e.g., ICAM-1) on keratinocytes and endothelial cells, reducing leukocyte recruitment to the site of inflammation. It also suppresses mast cell activity, thereby reducing histamine release and alleviating symptoms like redness and itching. UV light decreases nerve hypersensitivity, which helps alleviate pruritus (itching), a common symptom in contact dermatitis.[48]

❖ **Lipid Nanoparticles:** Lipid nanoparticles (LNPs) are advanced drug delivery systems composed of lipids that encapsulate active pharmaceutical ingredients (APIs), such as drugs, vaccines, or genetic materials (e.g., mRNA). Their design enhances drug stability, bioavailability, and targeted delivery.

❖ **Two main types used in dermatology are:**
Solid Lipid Nanoparticles (SLNs) are a class of advanced drug delivery systems designed to improve the stability, bioavailability, and controlled release of therapeutic agents. Composition of Solid Lipid Nanoparticles Solid Lipids: Examples: Glyceryl monostearate, stearic acid, palmitic acid, triglycerides (e.g., tristearin) Function: Provide a solid matrix for encapsulation, ensuring stability and controlled release. Emulsifiers (Surfactants): Examples: Polysorbates (e.g., Tween 80), lecithin, poloxamers. Function: Stabilize the nanoparticles and prevent aggregation.[49]

❖ **Nanostructured Lipid Carriers (NLCs)** are advanced lipid-based nanoparticle systems developed to overcome the limitations of solid lipid nanoparticles (SLNs), such as low drug loading and drug expulsion during storage. NLCs consist of a blend of solid and liquid lipids, creating a more flexible and less crystalline lipid matrix that can incorporate a higher amount of active pharmaceutical ingredients (APIs) Composition of NLCs Solid Lipids: Examples: Glyceryl monostearate, stearic acid, or hard fats like trimyristin. Function: Forms the structural backbone of the nanoparticle, providing stability. Liquid Lipids (Oils): Examples: Medium-chain triglycerides (MCTs), oleic acid, or oils like squalene. Function: Disrupts the crystalline structure of solid lipids, increasing drug loading and

preventing drug expulsion. **MOA Targeting Inflammation** LNPs deliver anti-inflammatory drugs (e.g., corticosteroids, NSAIDs) directly to the site of inflammation.[50] The localized delivery reduces the release of pro-inflammatory cytokines like TNF- α , IL-1 β , and IL-6, which mediate the inflammatory response. Drugs loaded in LNPs stabilize immune cells, such as mast cells and dendritic cells, preventing the release of histamines and other inflammatory mediators. **Skin Barrier Repair** LNPs containing ceramides or fatty acids replenish the skin's lipid matrix, improving hydration and reducing trans epidermal water loss (TEWL). The lipid structure also protects against further penetration of allergens or irritants, offering a protective barrier. **Creams/Gels:** Contain antioxidants like ascorbic acid or tocopherol in stabilized forms. **Lipid Nanoparticles:** Loaded with resveratrol, curcumin, or polyphenols for deeper dermal penetration.[51]

❖ Marketed Formulations for Contact Dermatitis:

Marketed formulation for contact dermatitis is topical corticosteroids, most often available as a cream or ointment containing hydrocortisone (1%) for mild cases, or stronger options like triamcinolone or clobetasol propionate for more severe cases, depending on the affected area and severity of symptoms; other options include calcineurin inhibitors like tacrolimus (Protopic) ointment for allergic contact dermatitis.[52] Novel formulation for contact dermatitis could involve incorporating advanced drug delivery systems like nano emulsions, liposomes, or microparticles to target the affected skin layers more effectively, potentially using ingredients like: These novel formulations represent significant advancements in the topical

management of contact dermatitis, offering patients more options tailored to their specific needs and improving overall treatment outcomes. Here are some common formulations that include active ingredients effective for managing contact dermatitis. [53]

➤ **Corticosteroid-Based Formulations:**

Clobetasol Propionate Cream (0.05%) Brand Example: Clobevate Indication: Reduces inflammation and itching by suppressing immune responses. **Hydrocortisone Cream (1%)** Brand Example: Cortizone-10 Indication: Mild corticosteroid for soothing irritation and redness.

Calcineurin Inhibitor Formulations: **Tacrolimus Ointment (0.03% and 0.1%)** Brand Example: Protopic Indication: Reduces immune response by inhibiting T-cell activation; used for long-term management. **Pimecrolimus Cream (1%)** Brand Example: Elidel Indication: Effective for mild to moderate allergic contact dermatitis.[54]

➤ **Antioxidant-Enriched Formulations:**

Vitamin C Serum (L-ascorbic acid 10–20%) Brand Example: CeraVe Skin Renewing Vitamin C Serum Indication: Neutralizes ROS, reduces redness, and promotes skin repair.

Vitamin E Cream (α -Tocopherol 5–10%) Brand Example: Epaderm Cream Indication: Restores lipid barrier and soothes irritation. **Niacinamide Cream (5%)** Brand Example: La Roche-Posay Cicaplast Baume B5 Indication: Reduces inflammation and strengthens the skin barrier.[55]

➤ **Antioxidant and Herbal Formulations:**

Green Tea Polyphenol Creams Brand Example: Replenix CF Cream Indication: Reduces redness and oxidative stress. **Curcumin-Based Gel** Brand Example: Curaderm Indication: Anti-inflammatory and



antioxidant for soothing skin. **Moisturizers and Emollients:** Colloidal Oatmeal Cream Brand Example: Aveeno Eczema Therapy Indication: Soothes itching and irritation while hydrating the skin. Ceramide-Enriched Moisturizers Brand Example: CeraVe Moisturizing Cream. Indication: Repairs the skin barrier and prevents water loss.[56]

➤ **Phosphodiesterase-4 (PDE-4) Inhibitors:** Crisaborole Ointment (2%) Brand Name: Eucrisa Mechanism: Inhibits PDE-4, leading to reduced production of pro-inflammatory cytokines. Indication: Approved for mild to moderate atopic dermatitis, it has shown efficacy in reducing inflammation and pruritus associated with CD.

➤ **Janus Kinase (JAK) Inhibitors:** Ruxolitinib Cream (1.5%) Aryl Hydrocarbon Receptor (AhR) Modulators Tapinarof Cream (1%) Brand Name: Vtama Mechanism: Modulates the AhR pathway, leading to anti-inflammatory and skin barrier-enhancing effects. Indication: While primarily approved for psoriasis, studies indicate its potential efficacy in treating inflammatory skin conditions like CD.[57]

➤ **Aryl Hydrocarbon Receptor (AhR) Modulators:** Brand Name: Opzelura Mechanism: Inhibits JAK1/JAK2 pathways, thereby modulating immune responses and reducing inflammation. Indication: Recently approved for atopic dermatitis, it offers potential benefits for CD patients, especially those unresponsive to traditional therapies.

➤ **Microbiome Modulating Therapies:** Topical Probiotics and Prebiotics Mechanism: Aim to restore the natural skin microbiome balance, thereby enhancing the skin's barrier function and reducing

inflammation. Indication: Emerging as adjunctive treatments for CD, though more research is needed to establish efficacy.[58]

➤ **Novel Delivery Systems:** Nanostructured Lipid Carriers (NLCs) Example: Tacrolimus-loaded NLCs Mechanism: Enhance skin penetration and provide controlled release of the active ingredient, improving efficacy and reducing systemic absorption. Indication: Offers a promising approach for delivering immunomodulators in CD treatment.[59]

CONCLUSION

Contact dermatitis (CD) remains a prevalent inflammatory skin condition with significant implications for patient quality of life. While traditional treatments such as corticosteroids and antihistamines have been the mainstay of therapy, emerging treatments offer promising alternatives with potentially improved efficacy and safety profiles. Novel topical and systemic agents, including phosphodiesterase inhibitors, Janus kinase (JAK) inhibitors, and targeted biologics, are reshaping the therapeutic landscape. Additionally, natural compounds such as dandelion leaf extracts are gaining attention for their potential anti-inflammatory and barrier-restoring properties. Future research should focus on large-scale clinical trials to confirm the efficacy and safety of these novel approaches. Personalized treatment strategies based on molecular mechanisms and patient-specific factors may also play a crucial role in optimizing CD management. As the field advances, integrating these innovative therapies into clinical practice could provide more effective, tailored solutions for patients suffering from CD.

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