Dermatitis: An educational review

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Abstract

Skin accounts for 7 percent of our body weight. It helps protect the body from external and internal threats and maintains bodily temperature. However, the epidermis and dermis are not known to be impermeable to chemicals. When toxic substances (irritants and allergens) permeate the skin layers, they result in skin inflammation. Skin hazard classification is critical in cosmetics as it helps to understand the impact of ingredients on people's everyday routines. This segment addresses irritative or allergic contact dermatitis, and how irritants can lead to inflammatory skin diseases. Contact dermatitis from photo irritants and photosensitivity are both light reactions, and they seem to occur when exposed to the resulting mixture of the chemical. It is thus crucial to perform research on these diseases and the effects of chemicals on the skin under sunlight (UV light) to safeguard human skin. Since almost all cosmetics are applied to the face and body, product safety is essential.

Index Terms: Skin, Cosmetic, Contact dermatitis, Disease

INTRODUCTION

The skin is the largest organ in the body, and one of its physiological functions is to serve as the first line of protection against exogenous agents. The skin, on the other hand, should not be perceived as an impenetrable physicochemical barrier. Numerous compounds with low molecular weight are capable of breaching this barrier. When toxic agents (such as irritants or allergens in cosmetic products) permeate them, the resulting adverse effects can cause the

user considerable discomfort. Even minor changes to the skin's surface may cause discomfort, especially in the facial region, which is densely packed with sensory nerves. Superior skincare options, as well as the use of products that help preserve and maintain the optimal pH of the skin, help protect and support the skin's natural defenses, making it more durable and less sensitive[1]. They help skin maintain its natural appearance and feel while also assisting it in performing its protective function. Though chemical irritants are typically the most well-known causes of skin inflammation, physical, biological, and environmental factors all contribute to irritation. Additionally, since the majority of cosmetics are applied to the extremely permeable facial skin, the majority of cosmetic reactions are registered on the face. As a result, cosmetic product protection is important.

DERMATITIS AS A RESULT OF CONTACT

This is a broad term that refers to any inflammatory skin condition caused by contact with an irritant or allergen. An irritant is any agent, physical or chemical, that, when applied for an extended period and inappropriate concentrations, is capable of causing cell damage. Whichever agent is responsible, the clinical manifestations are similar: itching, redness, and skin lesions.

Contact dermatitis is an inflammatory condition of the skin caused by exposure to a variety of substances. Detergents, toiletries, pesticides, and even natural goods such as food and waterfall under this category. It can impact any part of the body but is most often seen in the hands, feet, and groin. It is not infectious. Typically, it results in an acute eruption. Eczema is a type of dermatitis. Additionally, it is referred to as atopic dermatitis. Certain forms of dermatitis include erythema, macules, vesicles, bullae, and even necrosis. It is a product of an exogenous cause[2]. Inflammation occurs in the epidermis and dermis layers of the skin in contact dermatitis.

Prevent contact dermatitis by using fragrance-free moisturizers. Utilize mild soaps and cleansers that are scent- and dye-free. Since coming into contact with a reported allergen or irritant, wash immediately.

What factors contribute to the development of contact dermatitis?

• It is caused by interaction with irritants. Contact dermatitis is mostly caused by irritants and allergens. Contact dermatitis is a condition that is determined by the number of irritants exposed.

• Allergens: These substances elicit an allergic response, resulting in inflammation. An allergen is a type of antigen that triggers an abnormal immune response in which the immune

system defends the body against a threat that would be harmless otherwise. Allergies are a term that refers to these types of reactions. Chemicals, like histamine, are released as a result of a series of events. This is what results in an allergic reaction. Allergens are substances, protein or nonprotein, that can cause allergy or specific hypersensitivity when they come into contact with your immune system. Nickel, rubber, cosmetics (perfumes and preservatives), poison ivy, latex gloves, and proteins in some vegetables and fruits are all examples of allergens[3].

• Irritants: are substances that irritate when they come into contact with the skin and are characterized as a stimulus or agent that causes the state of irritation. Irritations may occur as a result of allergen exposure. • Phototoxic dermatitis develops when an irritant or allergen is caused by sunlight.

• Things that float in the air, such as sawdust or wool dust • Plants • Fertilizers and pesticides

Contact dermatitis symptoms

Dry skin • Severe itching • Redness • Swelling • The forming of tiny blisters or wheals (itchy, red circles with a white center) on the skin

Contact dermatitis treatment

Contact dermatitis that is mild to moderate does not need treatment. The majority of rashes resolve within 2-4 weeks, and mild cases can resolve within a few days. However, there are many over-the-counter or home remedies that can help alleviate symptoms and speed recovery, including the following:

• 1% hydrocortisone cream • Calamine lotion • Moisturizers • Oatmeal compresses. Corticosteroid creams can help alleviate swelling and itching.

• Oral steroids: Prednisone is a form of steroid that can be used to treat rash symptoms that are not relieved by antihistamines or other treatments.

• Immunosuppressive medications: When repeated doses of oral steroids are needed in extreme cases.

Allergic Contact dermatitis (ACD)

Contact dermatitis due to allergens is less common than contact dermatitis due to irritants. It happens as a result of the skin developing an allergic reaction to foreign material. This allows the body to release inflammatory chemicals, which can irritate and itch the skin.

ACD occurs when a substance comes into contact with skin that has developed a particular change in its reactivity as a result of previous exposure to the substance that causes dermatitis. ACD's skin response is delayed, immunologically mediated (Type IV), and manifests as erythema, edema, papules, and papulovesicular in varying degrees. Patch testing is the gold

standard; it is needed for establishing ACD, identifying the allergen, and predictive testing (determining safe materials for the consumer, and exclusion of other diagnoses).

Allergic response

Allergens are molecules with a low molecular weight (500–1000 Da) capable of penetrating the skin and binding to skin proteins to form a variety of different antigens that can elicit an allergic response in a person. Fragrances (e.g., cinnamic aldehyde) and preservatives are common allergens in cosmetic products (formaldehyde and formaldehyde donors). Just a small percentage of people who come into contact with an allergen develop allergic contact dermatitis[4].

Allergic contact dermatitis causes

1. Nickel, which is used in jewelry, eyeglass cases, and buckles, is the most common source of ACD.

2. Poison oak, also known as poison ivy

This plant's leaves, buds, branches, and roots have an oily sap that contains an allergen called Urushiol. An allergic reaction may be triggered by either direct contact with a damaged plant component or indirect contact with urushiol oil-contaminated clothing, equipment, footwear, or pets, or inhalation of smoke from a burning poison ivy plant. The chemical elicits an allergic reaction at the site of contact, resulting in contact dermatitis and a skin rash.

3. Formaldehyde, a volatile organic compound used in preservatives, disinfectants, and clothes.

Some individuals develop allergic contact dermatitis as a result of personal care items and substances.

4. Personal care items such as deodorants, shampoos, conditioners, hair dyes, cosmetics, and nail polish

5. Substances carried in the air, such as ragweed pollen and spray insecticides

6. Products that cause an allergic reaction when exposed to sunlight (photoallergic contact dermatitis), such as some sunscreens and oral medicines.

7. Nickel is a metal that is used in jewelry, buckles, and a variety of other objects.

8. Antibiotic creams and oral antihistamines

9. Peruvian balsam, which is used in a wide variety of items, including perfumes, cosmetics, mouth rinses, and flavorings (cloves, Jamaican pepper, and cinnamon and other sources such as colas, tobacco, wines, and vermouth)

Cobalt is a metal that is often used in combination with nickel, chromium, tungsten, and molybdenum. It is used in the manufacture of jewelry snaps, buttons, and instruments, as well as cosmetics, hair dyes, joint replacements, ceramics, enamel, cement, paints, and resins.

11. Creams emollients (Lanolin)

Allergic contact dermatitis symptoms include blistered areas, scaly skin, itchy red skin that may occur in patches • burning sensation, and sun sensitivity. These symptoms can last between two- and four weeks following exposure.

What are the diagnostic criteria for allergic contact dermatitis?

1. Use of provocative language test

It confirms a positive closed patch test reaction to a substance's ingredients and is used to evaluate items that are intended to remain on the skin after application.

2. Photopatch review

To determine contact photoallergy to sulfonamides, phenothiazines, oxybenzone, and musk ambrette.

3.Patch verification:

Patch examination is a technique used to diagnose contact dermatitis caused by nickel, cosmetics, perfumes, or household chemicals. Contact allergy is not a life-threatening reaction, but rather a slower mechanism through which the immune system responds to specific chemical substances. Instead of allergic antibodies, the body develops hypersensitivity.

How Is a Patch Test Conducted?

Before the patch test, the individual will be asked to abstain from certain drugs (such as topical steroids) and from using a tanning bed, especially on the back. Typically, the repair test is done on the back.

• The patch is composed of several allergens that are added in small dots to an adhesive film. Each patch is applied to the back of the person and stays in place for 48 hours. It is important not to get the patches wet during this period, so showers, baths, and unnecessary sweating should be avoided.

• The patches will be removed at the doctor's office after 48 hours. Before that, each patch's position will be identified with an indelible surgical marker. This will serve as a guideline for the doctor when you return to the clinic for a final examination. At this stage, it is critical to obey physician instructions about bathing, and if bathing is allowed before the final reading, avoid scrubbing the pen marks. Although itching or a rash can occur at the patch site, it is critical to avoid scratching or treating it until after your final doctor visit[5].

• The final assessment will take place between 72 and 96 hours after the initial placement. Any reaction will be recorded, offering insight into which drugs to avoid and which treatment options to explore.

Patch testing is non-invasive and, unlike allergy testing, does not require any needles. Certain individuals, especially those with multiple reactions, can become itchy and want to scratch their skin, but this should be avoided before testing is complete. Children will be checked until they reach the age of comprehension about the inability to remove the patches.

Since the aim of patch testing is to determine the cause of contact dermatitis, one or more reactions can occur at test sites. A positive test result may be accompanied by redness, bumps, moderate swelling, or the formation of a small blister. Although certain reactions can be unpleasant, they are usually mild.

Bear in mind that the number of patch checks that can be done is infinite. The standard panels contain at least 30 objects. A negative patch panel test does not necessarily mean you do not have contact dermatitis; it simply means you are not sensitized to any of the reagents tested. Additional panels can be recommended based on the history if the initial patch test panel is negative.

Similarly, positive findings do not always indicate that those particular reagents triggered your contact dermatitis; rather, your positive outcome must be matched with your background to determine if those chemicals were the cause of the reaction. If the positive outcome does not correlate with the patient's history, additional panels may help elucidate other possible allergens in touch.

Once all patch test readings are complete, any scratching or rash can be treated with a topical steroid.

Patch monitoring is used to diagnose chronic, recurrent contact dermatitis in patients. Additionally, a skin biopsy and culture of the skin lesion can be used to diagnose contact dermatitis and rule out other possible causes of the symptoms.

A patch test is based on the concept of type IV hypersensitivity.

1. When the skin is exposed to an allergen, antigen-presenting cells (APCs), also known as Langerhans cells or Dermal Dendritic Cells, consume the material (phagocytose) and break it down into smaller parts. This is the point at which a substance is recognized by skin immune cells.

2. They then attach fragments of the material to their surface (technically, the main histocompatibility complex type two retains the fragment of the molecule on the surface) (MHC-II).

3. After this is accomplished, the APC proceeds down the lymphatic pathway to a lymph node, where it introduces this portion of the material (which we now refer to as an antigen) to a specific immune cell known as a CD4+ T-cell or T-helper cell.
4. If the T-cell identifies the material as toxic, it multiplies and sends more of itself to the site of antigen exposure.
5. When the skin is exposed to the antigen again, the memory T cells in the skin recognize it and release cytokines (chemical signals) that stimulate the migration of additional T cells from blood vessels. This initiates a complicated immune cascade that results in skin inflammation, itching, and the characteristic contact dermatitis rash.
6. In general, it takes between two and four days for a patch testing response to evolve. The patch test is just a small area of contact dermatitis induction. Interestingly, the molecule must be ten times the size of the smallest molecule that can move through the skin to be picked up and recognized. As a result, an antigen (such as nickel) may interact with something else before being noticed.

Allergy-related contact dermatitis: treatment options[6]

- Apply cool compresses to the irritated area of the skin to alleviate itching.
- Requires the detection of allergens that cause allergic reactions
- Corticosteroids, either topical or systemic, should be used to clear dermatitis.
- Even though allergens are prevented, complete and sustained clearance can take up to six weeks or more.
- Symptoms typically resolve without treatment within two to four weeks, but some medications can expedite healing as long as the trigger is avoided. Additionally, if the allergen is not detected and removed, the disease can become chronic.
- The first step in treating the disorder is to appropriately identify the clinical issue, followed by identifying the responsible chemical and its source. Corticosteroid creams should be used cautiously and according to the manufacturer's instructions, as prolonged use can result in skin thinning. Additionally, calamine lotion and cool oatmeal baths can help alleviate itching in some cases, such as poison ivy dermatitis.
- Extreme cases are treated with systemic corticosteroids that are tapered progressively over 12 – 20 days to avoid recurrence of the rash (while the chemical allergen remains in the skin, up to 3 weeks), as well as a topical corticosteroid. Tacrolimus ointment or pimecrolimus cream can also be used in addition to or in place of corticosteroid creams. In more serious cases, oral antihistamines such as diphenhydramine or

hydroxyzine can be used to sedate the patient and alleviate the extreme itching. Topical antihistamines are not recommended because the lotion itself can cause a second skin reaction (treatment-associated contact dermatitis).

How will allergic contact dermatitis be avoided?

- Stop allergens and irritants, as well as chemicals, are known to cause an allergic reaction on the skin.
- Hands and other body areas should be washed with mild, fragrance-free soap and warm water[7].
- Protect yourself by wearing protective clothing or gloves. Face masks, goggles, gloves, and other protective clothing can help protect you from irritating substances such as household cleaners.
- Apply a barrier cream or gel to the affected area. These products can act as a barrier to your skin. For instance, an over-the-counter skin cream containing bentoquatam (Ivy Block) can help prevent or alleviate a reaction to poison ivy on your skin.
- Apply moisturizers daily

Pathology of allergic contact dermatitis

The contact between skin immune cells and specific antigens on the sensitizer provokes an immune-mediated or allergic reaction[8].

The reaction takes place in two phases, as is mentioned below:

1.Sensitization – this is when the immune cells react to the hapten(penetrate the skin) in a specific manner. During this phase, non-specific immune cells pick up the hapten-carrier protein complex and migrate to the local lymph nodes. There they activate antigen-specific lymphocytes to produce a proliferative clone of T-cells which enter the circulation and enter the dermis. The sensitization process is now complete, and the new T-cells are ready to respond to the antigen if they encounter it. The whole process takes about 10-14 days.

In the sensitization phase Hapten penetrates skin then the biochemically transformed by epidermal enzymatic processes, conjugated with a carrier protein to become immunogenic then they are captured by antigen-presenting cells (APCs), particularly Langherans cells. it then gets processed, bound to class II MHC molecules, and exposed to the cell surface. Cytokines get produced by keratinocytes and APCs. The Langerhans cells migrate towards locoregional lymph nodes. Specific effector and memory T lymphocytes selected and clonally

proliferated then enter the bloodstream and reaches to skin and the subject is sensitized to happen.

2. Elicitation – this phase follows re-exposure to the antigen. The prepared T-cells mount an immune challenge that produces an allergic reaction. Increasing use can lead to persistent or severe reactions. This phase takes 24-48 hours, on average, the first time the antigen is picked up following sensitization. However, subsequent exposures bring about more rapid reactions, which is called anamnesis.

The second phase of Pathogenesis is known as **Elicitation.** Application of contact allergens (Ag) into a sensitized individual causes the release of cytokines by keratinocytes and Langerhans cells. These cytokines induce the expression of adhesion molecules and activation of endothelial cells which ultimately attracts leukocytes to the site of antigen application. Among these cells, T effector cells are present which are now activated upon antigen presentation either by resident cells or by infiltrating Langerhans cells. Antigen-specific T cell activation again induces the release of cytokines by T cells. This causes the attraction of other inflammatory cells including granulocytes and macrophages which ultimately cause the clinical manifestation of contact dermatitis. Ag, antigen; DDC, dermal dendritic cell; KC, keratinocyte; CLA, cutaneous lymphocyte antigen. (New contact penetration of skin then Substance undergoes chemical changes, recognized and processed by Langerhans cells then Specific T lymphocytes are recalled at skin level and, together with keratinocytes, release numerous cytokines, amplify inflammatory response which gives rise to skin damage).

Both the phases are depicted in Figure 1.

ACD- Pathophysiology

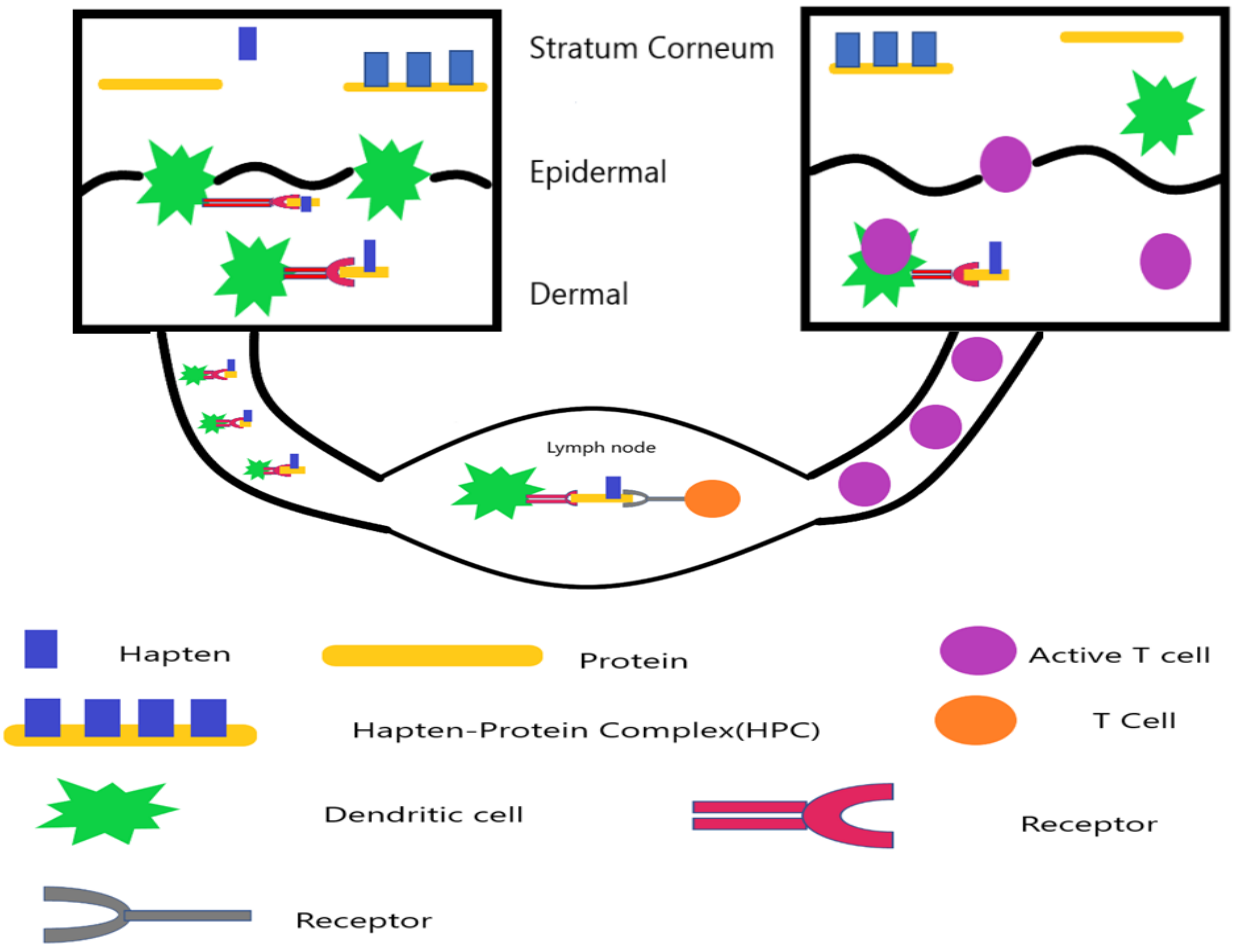

Figure 1: Pathophysiology of Acute contact dermatitis

Invariably, active dermatitis is treated as follows:

- Creams emollients
- Steroids applied topically
- Antibiotics, either topical or oral, for secondary infection
- For extreme situations, oral steroids are normally prescribed in short courses.
- Phototherapy is often referred to as photochemotherapy.
- Azathioprine, ciclosporin or a different immunosuppressive agent can be used[9].
- Tacrolimus ointment and pimecrolimus cream are both calcineurin inhibitors that are beneficial in the treatment of allergic contact dermatitis.

How does allergic touch dermatitis manifest itself?

Since contact allergies frequently last a lifetime, it is important to recognize the allergen and avoid touching it. Dermatitis can recur if the allergen is reintroduced. Certain allergens are more difficult to avoid than others, with airborne allergens posing the greatest difficulty (eg epoxy resin, composite pollen)[10]. The longer a person suffers from extreme allergic contact dermatitis, the longer it will take for the condition to resolve until the diagnosis is made and the cause is identified. Dermatitis can resolve with avoidance of the allergen, but it may also continue indefinitely, as in the case of chromate allergy. The prognosis is dependent on patient education and compliance with allergen avoidance and proper skincare.

CONCLUSION

To ensure the safety of a cosmetic product, the safety evaluation shall be based on risk assessment data for the ingredients used in the product, as well as the method of use, the amount of use, and impurity exposure. After a finished product's risk assessment, a human patch test can be used to rule out skin discomfort or sensitization if the ethical criteria are met. Additional tests such as immunological tests, Vivo tests, prick tests, scratch tests, human methods, and rabbit ear assay tests can be performed to confirm. Individuals may also develop allergies to commonly used products. They contain no harmful ingredients, and the body can simply respond differently to them, which differs from person to person. Almost any material, whether natural or synthetic, can cause an allergic reaction to the skin. FDA approval is required for pharmaceuticals and cosmetics. Additionally, the product will bear a warning label and consumers will be encouraged to conduct an allergy test before applying the product fully.

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Conflict of interest

Authors declare none.

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