



ISSN Print: 2664-6188
ISSN Online: 2664-6196
Impact Factor: RJIF 5.35
IJCBB 2022; 4(1): 32-36
www.biochemistryjournal.net
Received: 12-02-2022
Accepted: 18-02-2022

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To check contact dermatitis contagion and health hazardous: A review

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DOI: <https://doi.org/10.33545/26646188.2022.v4.i1a.28>

Abstract

Skin is the largest organ of our body when it is exposed to exogenous irritants and allergens in 24 hours, these noxious agents cause immunotoxicity, and Contact dermatitis (CD) is one of them. Here in this review we had checked its types, main causes, Action mechanisms of irritants and allergens, Clinical aspects and its management: diagnostic tests, preventions and treatments of this contagion. There are two types of CD: first is the Irritant contact dermatitis (ICD) and second one is Allergic contact dermatitis (ACD). ICD is exposure of skin by physiological, biological, and chemical toxins resulting into rupturing of stratum corneum and release of cytokines which show inflammatory response. ACD is the interaction of xenobiotics with immune system. It is basically the immunotoxicity by chemicals which is developed by two phases (1) induction and (2) elicitation. Phototoxic and photo allergic CD is developed when CD is due to sunlight exposure. Management of CD is including (1) primary prevention: by avoidance or preventions at different levels (2) secondary prevention: when skin is affected by chemicals then diagnoses is very necessary by Patch test and photo Patch test (3) Tertiary prevention: treatment should be done as soon as possible by steroids and other products.

Keywords: Contact dermatitis, irritant, allergen, ICD, ACD, management

Introduction

The word "Dermatitis" means the skin inflammation which may be due to exogenous or endogenous agents but the term contact dermatitis (CD) is applied when any external or noxious agent gets in touch with skin and cause some irritation and/or allergic response. It is estimated that 5 to 9 percent men and 13 to 15 percent women are affected by dermatitis (English, 2004) [6]. It is responsible of 10% visit to hospital. Dermatitis is very common skin disorder with great socioeconomic influence. Skin is the largest organ of our body and due to large size to volume ratio it separates human body from external environment and greatly exposed by number of physical and chemical factors of the environment (Saint- mezar *et al.*, 2004; Martins and Reis, 2011) [18, 14] It act as a first line immune defense against the internal and external irritants (Chu *et al.*, 2011) [3] and Here, our main concern is exogenous irritants or exogenous dermatitis. The exogenous substances may have effect on skin directly ICD (irritant contact dermatitis) or due to some allergic chemicals when hypersensitivity of immune reaction delayed ACD (allergic contact dermatitis) (English, 2004) [6]. A Study is conducted in 2006 in which 210 patients were studied for five years and it is investigated that 58.5% have ACD and 41.4% have ICD and results of 5 patients are unclear. Results shows both are very common skin disorders (Racheva, 2006) [17].

Irritant contact dermatitis

ICD is the most common type of contact dermatitis. It is basically an eczematous (English, 2004) [6] and non-allergic (Frosch and John, 2011) [8] skin disorder (English, 2004) [6]. It is caused by physiological, chemical and biological toxins (Eberling *et al.*, 2014; Woolfson, 2008) [4, 25]. It is mainly the cytotoxic effect of noxious chemicals on the skin epidermis and dermis that is responsible of direct tissue damage (Martins and Reis, 2011) [14] Resulting the skin inflammation, skin burn, skin changes including cells destruction, water loss, release of pro-inflammatory cytokines and peptides (which is non-inflammatory response). Time period of irritation vary from person to person (Sasseville, 2008) [19] it depend upon the concentration of chemical, exposure time and repeating of exposure (Streit, 2001) [21].

These chemicals are in solid, liquid or gaseous form. Strong irritant agents include Acid and alkali resulting acute toxic effect and inflammation. The weaker substances including detergents or solvents are called cumulative irritants whose symptoms are redness and dryness of skin. Cumulative irritant CD commonly occur in sensitive parts of skin or thin skin especially in fingers and hands of workers such as nurses or in housewives. Main symptoms of ICD are itching and pain (Sasseville, 2008; Streit, 2001) ^[19, 21]. Now a day, Surfactants are broadly used. They may be cationic, anionic, Amphoteric or non-ionic agents. Many surfactant cause irritation reaction when skin is exposed to them (Effendy and Maibach, 1995) ^[5]. There are some common ICD agents are: Soaps, Strong acids, Strong bases, Alcohols solutions, Rubber additives, Organic solvents, Detergents, and also many others (Racheva, 2006) ^[17]. Approximately 80% of contact dermatitis is ICD and remaining is due to allergic and others (Eberting *et al.*, 2014) ^[4]. There are following types of ICD:

Subjective ICD

It is the minute contact to any irritant especially on face. It is due to cosmetics or any other irritant.

Acute ICD

It is the brief exposure to any strong irritant e.g. strong alkali, strong acid or any other solvent.

Chronic ICD

It is the repetitive exposure to any weak irritant it may be wet or dry e.g. detergent, soap, dust, air etc (English, 2004; Wilkinson *et al.*, 1970) ^[6, 24].

Mechanism

Its mechanism consists of three steps: irritation or disruption of skin barrier, epidermal cells stimulation and finally inflammation.

Irritation or Skin barrier disruption

Skin have barrier that protect the underlying tissue from any external danger from mechanical stress, dehydration and any chemical. There is a stratum corneum in the Skin which has stacked kerationcytes and an acid mentle that protects the skin and limit the absorption of molecules. When skin exposed to any irritant it will damage the stratum corneum. Then water is released from skin and irritants will penetrate in the skin (Eberting *et al.*, 2014) ^[4].

Stimulation of Epidermal cells and release of cytokine

After, entering the irritant into the skin it will react with kerationcytes which is a key factor of cytokines release that activates the T-cells. After this kerationcytes are damaged then a cascade of events occurs and activation of innate immune system and release of pro-inflammatory cytokines that are the: Interleukin IL-1 α , IL-1 β , IL-6 and TNF- α (Eberting *et al.*, 2014) ^[4].

Allergic contact dermatitis

It is the interaction of xenobiotics with the immune system. It is basically the immunotoxicity in humans due to many chemical agents that are hundreds in numbers cause skin disorders. It is more common environmental and occupational issue (Kimber *et al.*, 2002) ^[12]. Some common ACD agents are following:Metals-Ni,Cr,Co; Cosmetics and

skin care products; from clothes and shoes; Drugs; Plants; (Saint-meazard *et al.*,2004; Sasseville, 2008) ^[18, 19] Medicaments – neomycin, benzocain, chlornitromycin; Peruvian balsam; Parabens (Paraben Mix)- Nipabutyl, Nipagin A, Nipagin M,Nipazol M; Rubber additives - Thiuram Mix, Phenylendiamin, Diphenyl-p-phenylendiamin, Mercaptobenzthiazol; Formaldehyde; Scents (Parfum Mix)-cinnamat alcohol, cinnamataldehyd, Eugenol, Isoeugenol, Garanil; Detergents; Antiseptics and many other allergens (Racheva, 2006; Sasseville, 2008) ^[17, 19]. Formaldehyde is widely used chemical and occupational people are commonly affected by this irritant. It is also present in dental material. Skin is very sensitizing to this irritant (Lyapina, 2012) ^[13]. In modern era plastic is widely used in the world with increasing demand e.g. food packing, storage, in every phase of food production and transportation with safety and security. It is manufactured by many harmful substances such as Poly Methyl Methacrylate (PMMA).In 2011 three million ton PMMA is manufactured globally. MMA is monomer which is a low level residue also low molecular weight and low toxicity but when it leach out during handling process it act as a irritant and cause ACD (Pemberton and Lohmann, 2014) ^[16]. In children ACD start at early infancy mainly on lower legs (Waard-van der Spek *et al.*, 2013) ^[23]. But its ratio is low it is ~20% of all dermatitis in children (Mortz and Andersen, 1999) ^[15]. It is due to haptens in shoes or in socks. Toys, cosmetics, lipsticks, perfumes are also the cause of ACD. Children are commonly affected by metals (Waard-van der Spek *et al.*, 2013) ^[23] (e.g.Ni=0.9 to14.9% and Co=0.5 to 5.7% cause ACD in children) (Mortz and Andersen, 1999) ^[15], rubbers, neomycin, preservatives and colorings (Waard-van der Spek *et al.*, 2013) ^[23].

Mechanism

ACD develop by two phases (1) induction and (2) elicitation. When skin is exposed to the specific amount of any chemical they cause skin sensitization by cutaneous primary immune response. If an individual not show primary response then a vigorous secondary response occurs that is ACD or cutaneous inflammation. So, ACD is a delayed type of hypersensitivity. It depends upon the T-Lymphocytes (Kimber *et al.*, 2002; Johansen *et al.*, 2014) ^[12, 27]. T-Lymphocytes mediate the reaction especially the CD4+ T-helper and CD8+ T-cytotoxic cells are involved (Kimber and Dearman, 2002) ^[26].

Induction phase: Exposure, processing and transport of Allergence

Allergence is any chemical or irritant that first encounter with skin epidermis (Kimber *et al.*, 2002) ^[12] and penetrate the stratum corneum; mostly they are small lipophilic molecules (Sasseville, 2008; Saint-meazard *et al.*, 2004) ^[18, 19]. Epidermis consists of Langerhans cells (LC) and Dendritic cells (DC). Finally, allergence reached the LC that is involved in recognition of antigen and transportation through skin by afferent Lymphatic or Lymph nodes. During this migration LC are induced to differentiate from antigen processing cells into DC that are mature stimulatory cells that will present the antigen effectively to Lymph nodes. This all process is regulatory by cytokines and chemokines receptors in the epidermis. Cytokines include TNF- α and interleukin IL-1 β , IL-18 and IL-10. Effectiveness and transport of irritant depend upon the

amount of irritant and on the epidermal cytokines induced and up regulate the process (Kimber *et al.*, 2002; Sasseville, 2008; Saint-mezard *et al.*, 2004)^[12, 18, 19].

Elicitation phase: Activation of T-Lymphocyte and elicitation of Hypersensitivity

When DC represent the allergenic epitope to T-Lymphocytes which will induce to divide and differentiate the cells into clonal allergic T-cells. So, when skin again encountered with induced allergen then a more aggressive response will elicit this is called secondary immune response. T-cells (which play central role in immune response) are Th-1 and Th-2 and cytotoxic cells such as Tc1 and Tc2 are differentiated which further involved in the production of cytokines. Th1 cells are involved in the sensitization and elicitation of allergic reaction. Lymphocytes have clonal proliferation and differentiate into most important effectors CD4+ and CD8+ T- Lymphocyte (Kimber *et al.*, 2002; Kimber and Dearman, 2002; Johansen *et al.*, 2014; Saint-mezard *et al.*, 2004; Sasseville, 2008)^[12, 11, 27, 19].

Photo allergic contact dermatitis

When skin is exposed to sunlight then CD is classified as Phototoxic CD and photo allergic CD. Phototoxic CD is similar to the ICD but there is sun exposure of skin. Similarly, photo allergic CD is also due to sun exposure which convert the inert contents into allergic contents and elicit the body immune response (Martins and Reis, 2011)^[14].

Id reactions

It is caused by fungal or any other antigen reaction resulting into acute inflammation (Woolfson, 2008)^[25].

Management of contact dermatitis

Primary prevention is Engineering control

First of all find the irritant at your work place and try to remove it if possible removal of chromium with cement is a successful example in Europe (Fonacier *et al.*, 2015)^[7]. If removing is not possible replace that chemical or allergen with less hazardous one. If contact dermatitis occur by air due to dust, mist or vapor then local ventilation is necessary (Al-Otaibi and Alqahtani, 2015; Fonacier *et al.*, 2015)^[1, 7].

Personal protection

Put gloves with cotton liner inside, goggles and/or face shield, boots, apron and uniform to protect skin at work place. While purchasing gloves keep in mind that gloves stuff should be according to nature of chemical because some chemicals can penetrate the gloves. Uniform should be

periodically checked and discarded if any hole is present (Al-Otaibi and Alqahtani, 2015; Bourke *et al.* 2009; Fonacier *et al.*, 2015)^[1, 2, 7].

Barrier creams

Some barrier creams are available in market use it before and after work to avoid irritants. Water resistance creams contain silicone which protect against water, acids and alkalis and dyes that are water soluble. Barrier creams contain quaternium-18 bentonite or contains pentaacetic acid which prevent from some metals such as nickel, chrome, copper etc (Al-Otaibi and Alqahtani, 2015; Fonacier *et al.*, 2015)^[1, 7].

Hygiene

Wash hands after work with soap and dry each time properly. By washing hands with soap remove the irritants and allergens. But don't over use the skin clearing agents which may cause CD. Clothing or uniform should be properly washed. Beside personal protection also work place area should be clean. For avoiding irritants or allergens at work place eating, drinking and smoking should be prohibited (Al-Otaibi and Alqahtani, 2015)^[1].

Education and health awareness

Training to avoid the exposure is important factor in work place (Al-Otaibi and Alqahtani, 2015)^[1].

Administrative control

If your skin is sensitized with certain chemical make sure do not exposed to that chemical again and again. This is the last control if above strategies are failed. For minimizing the exposure to allergens work shift rotation strategy is used (Al-Otaibi and Alqahtani, 2015)^[1].

Regulation: Warning signs and labels should be placed at all containers or products having hazardous chemical (Al-Otaibi and Alqahtani, 2015)^[1].

Secondary prevention is Diagnose of Problem

For distinction between exogenous and endogenous dermatitis and between ICD and ACD proper diagnose is necessary (English, 2004)^[6]. Diagnosis depend upon the patient's history and physical examination. For occupational dermatitis some complementary test also required that is conducted by visiting to the workplace for identification of temperature, humidity, or mechanical and chemical irritant (Sasseville, 2008; Eberting *et al.*, 2014; Al-Otaibi and Alqahtani, 2015)^[6, 4, 1, 19]. In (Table.1) There are some features which help us to understand the difference between ICD and ACD.

Table 1: Feature difference between ICD and ACD

Feature	Irritant	Allergic
Location	Usually the hands	Usually exposed areas of skin, often the hands
Symptoms	Burning, pruritus, pain	Pruritus is the dominant symptom
Surface appearance	Dry and fissured skin	Vesicles and bullae
Lesion borders	Less distinct borders	Distinct angles, lines and border

(Usatine and Riojas, 2010; English, 2004)^[22, 6].

But it is dangerous to rely on these features so, proper testing is necessary for diagnose and treatment. Most common recommended test for contact dermatitis is patch test. Although, It is expensive and time consuming but it has

specificity between 70-80% (English, 2004; Usatine and Riojas, 2010; Bourke *et al.*, 2009; Saint-mezard *et al.*, 2004; Spiewak, 2008)^[6, 2, 18, 20, 22]. It is equally used in children and adults. There are two types of test methods: one is the

classical technique in which allergens, tapes and patches are separately applied and other one is TRUE test which is ready to use system in this only covering is needed to remove and all other things already prepared in advance. It is easy to use, give more accurate results and easily applied to large population (Mortz and Andersen, 1999; Spiewak, 2008) [15, 20].

Patch test

Many methods are used for patch test more common is Finn chamber in which chamber is supplied with 5 or 10 strips having aluminium disks and mounted on tape (for adhesive

property). Other system consists of plastic chamber having square shape placed on tape. TRUE Test Ready to use system are also available but limited however, it is best for discrimination between ICD and ACD. All material of patch should be stored in 4 °C. For patch usually upper back is chosen because it has large area for application of necessary number of tests. And also back surface is not exposed to sun light. Some-time upper arm or thigh also used for test but upper back is preferred site. Time of test is about 2 days (Johansen *et al.*, 2014; Saint-mezard *et al.*, 2004; Bourke *et al.*, 2009; Spiewak, 2008) [27, 2, 18, 20]. In Table 2. Possible patch test results are shown.

Table 2: Possible patch test results reading criteria recommended by International Contact Dermatitis Research Group (ICDRG)

Morphology/Description	Symbols	Remarks
Having no reaction	- or ø	Negative results
Mild erythema	?+	Doubtful results
Erythema, infiltration, possibly papules	+	Weak positive reaction
Erythema, infiltration, papules, vesicles	++	Strong positive reaction
Intense erythema, infiltration, coalescing vesicles, bullous reaction	+++	Extreme positive reaction
Glazed erythema, burn like erosion, pustules, edge effect. Various morphologies such as soap effect, bulla, necrosis	IR	Irritant reactions
---	NT	Not tested

(Saint-mezard *et al.*, 2004; Johansen *et al.*, 2014; Sasseville, 2008; Fonacier *et al.*, 2015; Jurado-Palomo *et al.*, 2011; Spiewak, 2008; Wilkinson *et al.*, 1970) [18, 27, 7, 10, 19, 20, 24].

Photo patch test

In case of photo allergic dermatitis photo patch test is recommended in this test UV light is necessary for hypersensitivity reaction. In this duplicate sets of allergens are prepared and applied on two areas then one irradiated and other one is shielded for about 2 days. If there is no reaction on non-irradiated site and show positive on exposed site then the result is positive for photo allergy. But if positive results on both areas it indicates the contact allergy (Bourke *et al.*, 2009; Johansen *et al.*, 2014; Spiewak, 2008) [2, 27, 20].

Tertiary prevention is Treatment

First priority is to recognize, avoid or eliminate the potential irritant. However, elimination is not possible all time. Identification and avoidance is the successful key for the treatment of irritant and allergic CD. If irritant or allergen is identified then recovery is easy e.g. if patient's skin is affected by cosmetic products then by recognizing allergen and informing to patient about that allergen great help in cure (Saint-mezard *et al.*, 2004; Bourke *et al.*, 2009; Fonacier *et al.*, 2015; Usatine and Riojas, 2010) [18, 2, 7, 22]. The treatment of CD depends upon its stage. At acute stage astringent soaks, wet dressing, calamine lotions, colloidal oatmeal baths, systemic or atopic steroids (for ACD systemic) and antihistamine are used for skin dryness and soothing the lesions (soothing therapies) (Al-Otaibi and Alqahtani, 2015; Usatine and Riojas, 2010; Sasseville, 2008; Saint-mezard *et al.*, 2004) [1, 18, 19, 22]. If big ulcer is developed by strong acids or alkalis then surgical process is applied or skin grafting may be needed but in very rare cases. At chronic stage in addition to steroids emollients are applied for skin dryness. If secondary infection is identified then antibiotics are also used (Al-Otaibi and Alqahtani, 2015; Sasseville, 2008) [1, 19].

Conclusion

After this through study it is concluded that contact dermatitis is very noxious skin problem and occupational peoples seriously affected by it. There are lot of exogenous

agents are present in the environment which is a great threat for peoples whose skin is very sensitive to these noxious agents. Main symptoms by these agents are itching, pain, and discomfort, rash and in severe cases burning also occur. Primary protection is very important step to avoid CD. Give guideline to patients to avoid the exposure of irritant agents again and again. Patient history is very critical for diagnosing. Patch test is commonly recommended test in all researches it is very expensive and time consuming it should not be recommended to every persons. If skin problem is unclear and confusing then it will be prescribed otherwise not. Treatment should be done continuously for better and quick cure. Some steroids cause allergic reactions in some peoples having sensitive skin so these steroids should not recommend to these patients.

Acknowledgment

There is no funding source for this article and no conflict of interest. I acknowledge to my co-authors for their keen interest and support and Department of Zoology of my institute where this review was done.

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