

## Reviews

### The need to improve screening and diagnostic methods in occupational irritant dermatitis

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### Abstract

Modern medicine has increasingly directed its interest towards discovering the etiology of occupational dermatitis, but unfortunately it is not completely elucidated. As with other occupational diseases, the presence of the exposure and the temporal relation between the exposure and the appearance of the characteristic signs is a defining element, but obtaining the information on the etiological factors is not always easy, therefore the attention must be directed to a systematic collection of these data. Clinical diagnosis is not sufficient, so additional paraclinical tests are needed for a complete diagnosis. Currently, more and more emphasis is being placed on experimental studies targeting the discovery of molecular or genetic markers that complement the idea of individual susceptibility in the appearance of contact dermatitis. As frequent as it is difficult to diagnose, occupational dermatitis is still a public health problem.

**Keywords:** irritant contact dermatitis, diagnosis, occupational etiology

### Introduction

Occupational contact dermatitis, defined as a skin condition, caused, conditioned, maintained or aggravated by the contact of the skin with an external chemical, physical or biological agent, with an irritating or sensitizing potential, existing in the workplace [1]. Although not always easy to demonstrate, occupational contact dermatitis accounts for between 33% and 45% of total occupational diseases [2]. At present, the pathogenic mechanisms that determine

the appearance and evolution of contact dermatitis are only partially elucidated, and there are still many unknowns in the explanation of their production.

Contact dermatitis with occupational etiology is a public health priority problem as established by the EU Commission in 2009 [3] with serious socio-economic consequences for employees (loss of jobs and long-term unemployment) and employers (decreased labor productivity). The most affected sectors are: chemical industry, metallurgical industry, food industry, beauty industry and medical sector,

cleaning and maintenance services.

Although nowadays the study of professional dermatitis has achieved a great extent in the world, in Romania the data from both the occupational medicine specialists and the dermatologists do not always integrate. However, dermatologists do acknowledge that in the etiology of the contact dermatitis, the most commonly incriminated are the substances the worker comes into contact at the workplace.

This information is in total discordance with the statistical data that shows a decrease in the number of occupational dermatitis cases declared in the last 10 years [4].

There are two etiological forms of contact dermatitis: irritant (orthoergic) dermatitis and allergic dermatitis. Irritating contact dermatitis accounts for approximately 80% of all occupational skin diseases, although some authors consider that there is an approximately equal distribution of the two forms [5].

In practice the clinical distinction between allergic dermatitis and irritant (orthoergic) dermatitis is difficult, often the patient has both orthoergic and allergic-type skin lesions, which is why many authors prefer the unitary description of the two conditions under the name of occupational contact dermatitis.

Irritant dermatitis is defined as skin inflammation caused by contact with a chemical agent (paints, dyes, cooling oils, organic solvents); in most cases, this is considered the true contact dermatitis.

There is also contact dermatitis produced by physical agents (high or low temperatures, excessive humidity, electric current, non-ionizing electromagnetic radiation), mechanical agents (which act by striking, repetitive microtraumas, high pressure) or biological agents (microbes, viruses, fungi, arthropods) [6].

The considerable increase of the number of occupational contact dermatitis in the last period is due to (1) the excessive chemisation of all sectors of production and consumption (2) the multiplication of the substances acting on the skin used in a series of production sectors (especially in the industry that produces and uses dyes and paints, detergent industry, rubber industry, pharmaceutical industry, beauty industry, food industry) (3) large and random variation of raw materials according to costs and suppliers, (4) employers' habit of eluding information regarding the substances used in the production processes (5) the non-use of adequate protective equipment.

The pathogenesis of contact dermatitis is incompletely elucidated: most authors consider that

skin lesions are the clinical expression of the imbalance between the aggressor factors and the defense capacity of the body. The difficulty of identifying a single pathogenic pathway also derives from the different degrees of injury of the skin barrier and the eventual triggering of an allergic-type mechanism. In summary, the pathogenic process can be outlined as follows: penetration of irritants through the skin barrier activates the keratinocytes and innate defense mechanisms (cutaneous release of pro-inflammatory cytokines, especially TNF, IL1, IL6). The inflammatory response to the aggression by the skin irritant is a response mediated by T lymphocytes, with the release of chemokines, attraction, and activation of neutrophils and macrophages [7].

Post-aggression repair may or may not be complete; most of the times, especially in chronic occupational exposure, the repair of the skin is incomplete: skin fibrosis, hyperkeratosis, decreased lipid protective layer, increased transepidermal water loss are factors that reduce the ability to defend against a new contact with the aggressor leading to the chronicity of the inflammatory process. Because the process is, in most cases, limited, the systemic resonance of these processes is reduced or even non-existent.

As the determination of the level of inflammatory markers directly at the level of the skin tissue is currently difficult, with the lack of systemic markers, the diagnosis, so necessary especially in support of the professional etiology, is almost impossible.

From a clinical perspective, irritant contact dermatitis consists of acute, subacute and chronic skin lesions. Acute irritant contact dermatitis occurs after the skin is exposed to a strong irritative agent, hours or even minutes after exposure. Chronic irritant contact dermatitis occurs after the skin has been exposed repeatedly to small concentrations of irritative agents leading to a cumulative effect that induces chronic skin damage by altering the lipid barrier of the horny layer and skin's acidic pH level [8]. For example, a dishwashing liquid frequently used could lead to chronic irritant contact dermatitis and the skin lesions will be present in the areas of the body in direct contact with the irritative agent.

Skin lesions in irritant contact dermatitis depend on exogenous factors, such as: intrinsic properties and dose of the irritative trigger, exposure duration and frequency, environmental factors (temperature, humidity, friction, contamination) and also on endogenous factors provided by the host, such as: genetic susceptibility, age, gender, race, skin barrier function, dry skin or other preexistent skin diseases, such as atopic dermatitis [9, 10].

The main characteristic of irritant contact dermatitis is that the lesions are sharply limited to the contact area, while lesions in allergic contact dermatitis tend to disseminate. Skin lesions in irritant contact dermatitis have a wide clinical spectrum. In the acute type, the lesions can range from erythema, edema, vesicles, bullae that can coalesce, hyperpigmentation, ulceration, to even necrosis in the chemical burn. In the chronic type, the cutaneous lesions are eczematous, with xerosis, scaling, painful fissures and lichenification. Although irritant contact dermatitis could affect any surface of the body, it predominantly affects the dorsal part of the hands and fingers, while allergic contact dermatitis affects the palms [12]. Sometimes in more severe cases irritant contact dermatitis could affect the entire surface of the hands and wrists.

While pruritus highlights allergic contact dermatitis clinically, in irritant contact dermatitis, the patient's symptoms consist mostly of burning, stinging sensation and pain.

A chronic exposure to an irritative trigger will lead to an altered skin barrier and changes in the skin morphology and also to increased permeability and vascular reactivity. These transformations induce a phenomenon called "hardening effect of the skin" or skin accommodation where the response to the irritant is decreased [13].

The skin accommodation consists of a hyperkeratotic and thicker stratum corneum, a thicker stratum granulosum, an increased TEWL and a reorganization of the lipid composition of the stratum corneum with an increased level in ceramide 1. Due to these skin changes, there will be a lower penetrance of the irritant, a more rapid irritant discharge, and a decreased inflammatory response [13, 14].

There isn't enough evidence for how long the skin should be chronically exposed to an irritant for the hardening phenomenon to occur and in this regard, more experimental studies are required to be performed in the future.

Although occupational irritant contact dermatitis is a frequent occupational disease among workers and it is more common than allergic contact dermatitis, sometimes its diagnosis can be quite challenging. Both irritant and contact dermatitis can sometimes coexist in the same patient, therefore prevention, avoidance of either allergic or irritative triggers, and treatment from onset must be rapidly established.

The pathogenic mechanisms are insufficiently known and there is no key marker to support the diagnosis of occupational disease. Therefore an extremely thorough anamnesis is required to formulate the diagnosis. This

includes the investigation of the general influence factors (smoking, alcohol consumption), family and personal medical history with special focus on the presence of any allergy or diabetes.

Of major interest are also the occupational exposure (the occupational age, the substances with which the subject comes in contact at the workplace), the type and location of lesions, the correlation of the onset and exacerbation of eczema with the type of occupational activities and the possible symptom improvement during holidays.

Association of the lesions with other symptoms such as itching, dry skin, is also required.

Equally, it is necessary to identify the protective measures used (gloves, creams) or the cleaning substances used at work or at home, substances that can erode the skin's lipid protective layer.

In the literature, several questionnaires are used, the Nordic Occupational Skin Questionnaire being the most popular [15].

There have been attempts to translate questionnaires used in other countries into Romanian, yet no publications are validating their use in practice [16], which may be much different than expected.

For example, a study in the UK in 2011 showed that using a 6-item screening questionnaire, as recommended by the UK Health and Safety Executive, identifies only two-thirds from those with cutaneous injuries [17].

A solution that could facilitate the diagnosis could be the use of a general questionnaire, which the occupational medicine doctors should customize through additional questions adapted to the specific working conditions of the people they supervise.

Based on literature data and our own experience, we propose the general questions to be included in a questionnaire to be the following:

1. General data: age, sex, height, weight
2. Habits: smoking, alcohol consumption
3. Hereditary history: the presence or the absence of allergic diseases (skin, respiratory, etc.), skin conditions (other than dermatitis) within the family on several generations
4. Pathologic personal history: the presence or the absence of allergic diseases; with emphasis on diseases that decrease the body's defense capacity
5. The presence of atopic dermatitis in childhood
6. Occupational history/curricula and occupational exposure, including current exposure
7. The affected skin areas
8. Skin symptoms (pruritus, burning sensation, pain) and skin rash signs (erythema, edema, papules, blisters, bullae, necrosis, xerosis, skin flakes and

fissures)

9. Hobbies / Extra-professional activities that involve contact with chemical substances or exposure to physical factors (mechanical, radiation, temperature variations)

10. Skin protection measures: gloves, emollient creams/protective barrier creams

11. Substances used in skin cleansing: at work and outside the work schedule

Based on these general questions, we have developed a specific questionnaire for workers in contact with dyes, which we apply in the exposed population. The results will be presented at the end of the study, hoping to contribute to improving the diagnosis of occupational irritant dermatitis. The introduction of common screening elements in occupational medicine and dermatological practice can contribute to a faster diagnosis of contact dermatitis.

The significant change in the quality of life of patients, and in certain situations even change in their professional trajectory these diseases can incur creates further research directions in the areas of pathogenic mechanisms and identification of accessible markers.

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