



Contact Dermatitis in the Elderly: Predisposing Factors, Diagnosis, and Management

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Published online: 29 April 2019
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Abstract

Increased aging of the general population is a well-known fact with serious effects on health systems worldwide. Skin aging involves various immunological and structural changes that increase the risk of numerous skin diseases such as contact dermatitis. Contact dermatitis is characterized by an inflammation of the skin caused by an interaction between the skin and external agents and is divided into irritant and allergic contact dermatitis. Irritant contact dermatitis occurs on skin areas directly exposed to irritant substances, which results in a stream of pro-inflammatory cytokines mediating the skin injury. Asteatotic and perineal irritant contact dermatitis are the most important subtypes of irritant contact dermatitis in the elderly. Allergic contact dermatitis is a T cell-mediated inflammatory reaction and requires a prior sensitization. The most common allergens responsible for allergic contact dermatitis in the elderly are fragrance mix, nickel, and balsam of Peru. Elderly patients with stasis dermatitis, chronic wounds, and chronic venous insufficiency have an increased prevalence of sensitization due to the frequent exposure to topical treatments. In this review, the most common types of contact dermatitis in the elderly are enumerated in order to assist dermatologists and other physicians to identify contact dermatitis in this distinct group of the population.

Key Points

Physiological skin-aging changes and skin dryness increase the risk for asteatotic dermatitis, the most common irritant contact dermatitis in the elderly.

Reduced epidermal skin barrier function and repetitive allergen exposure facilitate the development of contact allergies in the elderly.

1 Introduction

Increased aging of the general population is a well-known fact and has a severe impact on health systems worldwide. In 2017, about 13% of the global population was over 60 years

old. The current estimates predict that about a quarter of the population will be aged ≥ 60 years and the ≥ 80 -year-old population will triple, with the exception of the African continent, by 2050 [1]. With increasing life expectancy, there is a need for special attention to be given to providing appropriate care to elderly skin.

Natural age advancement results in decreasing sensitivity and specificity of immune system functions. This change may be called “immunosenescence” [2]. Furthermore, skin changes due to aging impair the epidermal barrier function [3]. Both aging factors promote a significantly increased risk of some skin diseases such as contact dermatitis.

Contact dermatitis is characterized by an inflammation of the skin caused by an interaction between external chemical agents and the skin. Two major types of contact dermatitis may be differentiated: allergic, with a prior immunological sensitization, and irritant, without a specific immunological mediation [4].

In this review, the most common types of contact dermatitis in the elderly are summarized in order to assist dermatologists and physicians to identify contact dermatitis in this distinct group of the population.

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2 Immunosenescence

Immunosenescence is defined by global age-associated immune dysfunctions [5]. Innate immunity interactions as well as the adaptive immune system are affected by age [5]. The cells of the innate immune system show an increase in receptor density and the production of proinflammatory cytokines, however, for yet unknown reasons this does not lead to an increased immune response [6]. Further, phagocytosis may be also reduced by neutrophils and monocyte/macrophage dysfunction [7]. The adaptive immune system shows with aging a thymus involution with a consequent decrease in T-cell generation, an imbalance of the lymphocyte sub-population, and hematopoietic stem cell dysfunction [8]. Decreased naïve lymphocytes and increased memory lymphocytes with growth of dysfunctional senescent cells have been described [8]. Likewise, the lymphopoiesis of B cells is also decreased [9]. Furthermore, the quality of humoral response is impaired and antibodies produced by aged B cells frequently show a low affinity and are less efficient [9]. Immunosenescence is also characterized by a chronic inflammatory status; this has been described as “inflammaging” [5]. Release of proinflammatory cytokines, such as interleukin (IL)-1, IL-2, IL-6, IL-12, IL-15, IL-18, IL-22, IL-23, tumour necrosis factor (TNF)- α , and interferon (IFN)- γ , have been reported in aged individuals [10].

All these processes provide a reduced resistance to infectious diseases, increased propensity to develop cancer, and more frequent autoimmune diseases in the elderly. The combination of immunosenescence with typical age-related tissue structure modification predisposes the individual to the development of allergic diseases [11].

3 Skin Aging

The main hallmarks of aging skin are dryness, atrophy, wrinkles, laxity, and pigmentary irregularities. These are consequences of multifactorial processes involving intrinsic and extrinsic components [3]. On one hand, genetic and hormonal factors, as well as metabolic substances, influence physiological intrinsic aging. On the other hand, environmental agents such as sunlight exposure, nicotine, repetitive mechanical trauma, and pollution may also contribute to the skin aging process [12].

Skin aging is intrinsically most influenced by genetic factors such as progressive telomere shortening [13]. This phenomenon is strictly associated with replicative senescence, working as a mitotic clock and coordinating the cell replication and regeneration [13]. MicroRNAs may play

an important role in cellular aging silencing genes, which are associated with cellular proliferation [14].

The dryness of aging skin is induced by the reduction of natural moisturizing factors and lipids in the stratum corneum, which decreases lamellar bilayers and water-holding capacity [15]. This has been demonstrated as an age-dependent decrease in transepidermal water loss (TEWL) [16]. Hormonal changes also influence the aging of skin, promoting earlier signs of aging in females [12]. Elsner et al. showed a reduced TEWL in postmenopausal women in comparison with premenopausal women [17]. Furthermore, sebaceous and sweat glands are diminished in elderly skin, contributing to skin dryness [18]. The surface pH of normal skin may be age-dependently increased [19]. When the pH increases, acidic-dependent lipid hydrolases β -glucocerebrosidase and sphingomyelinase, both enzymes involved in lipid processing, become inactive, impairing permeability and barrier homeostasis, and promoting skin dryness [19].

Aging skin may also present structural changes. The number of skin cell layers continues to be stable; however, the cells demonstrate constitutional alterations and decrease in thickness [12]. The epidermis exhibits a reduced number of cells with shorter and larger keratinocytes as well as bigger and less adherent corneocytes as a consequence of decreased epidermal turnover [12]. Melanocytes and Langerhans cells (LCs) are progressively decreased, impairing pigmentation and cutaneous immunity [20]. Likewise, vascular and cellular components of the dermis are decreased, leading to a loss of thickness and consequent atrophic aspect with advancing age [21]. The extracellular matrix may also be impaired and show reduced amounts of glycosaminoglycans, hyaluronic acid, and interfibrillary ground substance [22]. Due to the decrease of fibroblasts, the collagen synthesis is damaged, occasioning a decrease in collagen turnover [23]. The elastin fibres are also impaired presenting a higher degree of calcification and degradation [24]. Loss of elastin and collagen fibres leads to limited extensibility and elasticity and consequently to vulnerability. The overall volume of subcutaneous fat may also be reduced with age [12].

Extrinsic aging is caused by exogenous factors such as ultraviolet (UV) radiation, environmental toxins, and infectious agents. These induce DNA changes leading to damage of the skin [25]. UV irradiation is the most important extrinsic factor promoting photoaging through telomere shortening [13], whereupon UVB light (290–320 nm) plays a bigger role in DNA damage than UVA light (320–400 nm).

4 Contact Dermatitis

Contact dermatitis can be subdivided into allergic and irritant. Allergic contact dermatitis (ACD) is a T-cell-mediated inflammatory reaction and requires prior sensitization

[26]. In contrast, irritant contact dermatitis (ICD) is a consequence of innate immunological reaction to exogenous irritants and does not involve antigen-/allergen-specific T cells.

4.1 Irritant Contact Dermatitis (ICD)

ICD may develop on areas of skin directly exposed to irritant substances. The immune system is activated by direct skin damage caused by an irritant, which results in a stream of proinflammatory cytokines mediating the injury [27]. Molecular toxins directly affect keratinocytes, which subsequently release the innate immune mediators IL-1 α , IL-1 β , TNF- α , granulocyte–macrophage colony-stimulating factor (GM-CSF), and IL-8 [28]. These cytokines activate LCs, dermal dendritic cells, and endothelial cells, and the overall effect is the recruitment of neutrophils, lymphocytes, macrophages, and mast cells at damage sites [28].

Dryness is one important hallmark of aging and plays an important role in the development of the most common ICD (Table 1): asteatotic irritant dermatitis (AID), also known as exciccation eczema, winter dermatitis, or eczema craquelé [29]. Due to a reduction in air humidity during winter, AID may commonly appear at this time of the year. Another risk factor for the development of AID is intensive hygiene, such as inappropriate application of personal care products. In addition, use of hot water, shower gels, and cleansing products can also influence the dryness of the skin. Due to physiological changes of the skin, with the reduction of natural moisturizing factors and lipids in the stratum corneum, which reduce lamellar double layers and water storage capacity, the effect of intensive hygiene measures on seniors is significantly increased [15]. Clinical findings show dry skin with ichthyosiform scaling; the extremities are more often affected (Fig. 1). Itching is the most common symptom and has an important influence on the quality of life of these patients. AID may be treated with topical corticosteroids, moisturizers, and rich oil-based creams [30]. Moist compresses can also be applied; they can be used to treat moderate to severe eczema and allow greater penetration of moisturizers. Light therapy can also be applied. Appropriate



Fig. 1 Patient with asteatotic irritant dermatitis: clinical findings show dry skin with ichthyosiform scaling

Table 1 Most frequent trigger substances of irritant contact dermatitis in the elderly

Asteatotic irritant dermatitis:	
	Dry air (winter)
	Hot water
	Shower gels
	Cleansing products
Perineal irritant contact dermatitis:	
	Ammonia (urine)
	Lipases and proteases (stool)
	Wet work

skin care is an important step in protecting the skin barrier and preventing worsening of dermatitis. Moisturizers and special cleansing products are highly recommended.

Due to the increased prevalence of incontinence in older patients, perineal irritant contact dermatitis (PICD; also known as incontinence-associated dermatitis) is a common disorder in the elderly (Table 1). PICD is caused by prolonged direct exposure to physiological moisture such as urine or stool. Since the perianal region (faecal incontinence) and the genital area (urinary incontinence) show physiologically thinner skin, these areas are easier for irritant substances to penetrate and irritate [31]. Ammonia is the most important irritant component of urine. This agent neutralizes and alkalizes the skin pH value, which damages the acid protective layer of the skin and the skin barrier [32, 33]. In addition, the skin flora may change with an increase of the number of microorganisms. The change in pH also plays a role in the activation of faecal enzymes such as proteases and lipases. The activated enzymes lead to the lysis of skin proteins and lipids, especially from the stratum

corneum [34]. PICD is clinically characterized by erythema and inflammation in the genital area; in extreme cases, swelling and blisters can be seen. In the course of the disease, the skin barrier is damaged, resulting in excoriations and skin breakdown, which is a risk factor for superinfection of the skin flora [31]. A bacterial superinfection manifests itself with a purulent exudate. A fungal infection is characterized by white pustules especially in the marginal area (satellite pustules) [35]. In the case of persistent redness without signs of infection, effective washing and skin care with a hydrating barrier cream are indicated [31]. If the skin is damaged without signs of infection, the erosive areas should be treated with a barrier lotion. Bacterial superinfection should be topically treated with povidone iodine lotion; in the case of signs of a disseminated infection with redness and overheating, systemic antibiotic therapy should be considered [31]. Fungal superinfection may be treated with a paste containing miconazole. Appropriate skin care is an important measure to protect the skin barrier and prevent recurrence.

Wet work is another risk factor for the development of ICD. ICD has been described as a consequence of recurrent exposure to water and detergents, especially in occlusive environments. Wet work may increase the skin blood flow, the skin pH, and the permeability to low-molecular-weight irritants, playing an important role in the development of ICD [36]. Another important form of ICD is cumulative ICD, which is of great significance in occupational dermatology and commonly associated with wet work [37]. Cumulative ICD is caused by years of recurrent contact with irritating substances. Initially mild skin lesions may appear, which are often neglected until a pronounced dermatitis occurs. This disease is clinically characterized by dryness, erythema, lichenification, and hyperkeratosis [30]. There are currently very few data on the epidemiology of contact dermatitis in seniors. Nevertheless, this disease is important among the elderly and may be currently underestimated as the population is getting older and the number of aged workers is increasing.

4.2 Allergic Contact Dermatitis (ACD)

The pathophysiology of ACD is divided into two phases: sensitization and the effector (or elicitation) phase [26]. The first contact between skin and hapten occurs during sensitization. The haptens are captured by antigen presenting cells (APCs), transferred into the lymph nodes, and presented to the CD4 and CD8 cells, which leads to the proliferation of these hapten-specific cells [38]. This phase lasts between 8 and 15 days, and there is no clinical manifestation during this process. The hapten-specific T cells in the tissue start an immunological reaction upon renewed contact with the hapten after sensitization, characterizing the effector phase. In this phase, a clinical inflammatory process with erythema,

oedema, and in some cases blisters can be observed [38]. In contrast to sensitization, the effector phase is shorter and lasts about 2 or 3 days. In seniors, a reduced epidermal skin barrier function and repetitive allergen exposure with increasing age can predispose individuals to the development of contact allergies, while a weaker immune system reduces this disposition.

Epidemiological data on the prevalence of ACD in seniors are missing. Balato et al. analysed the prevalence of the most common allergens responsible for ACD in the elderly [39] (Table 2). Sensitization results from repeated encounters with allergens. Perfumed products are among the most common allergens in daily use. Due to advanced age, seniors have had a prolonged exposure to perfumed products, and it would be reasonable to expect the incidence of fragrance allergies to rise with increasing age [40]. Increased sensitization rates for fragrance mix have been described for women in the seventh decade of life and for men in the eighth decade of life [39, 40]. However, a decrease in fragrance mix sensitization was described in very elderly people [40]. Mahler describes fragrance mix as the most common contact allergen in patients over 65 years of age without comorbidities (stasis dermatitis, leg ulcers, or chronic venous insufficiency) in Germany [41].

Nickel sulphate is still one of the most common allergens in the elderly. Hypersensitivity to metals such as nickel, cobalt, palladium, and copper decreased with increasing age in the Austrian and Northern and Southern Italian populations [42–44]. Nickel was the third most common contact allergen in seniors aged > 65 years in a study in Germany [41].

The elderly also have an increased prevalence of sensitization to topical agents such as balsam of Peru, lanolin alcohols, paraben mix, diamino diphenylmethane, quinolone mix, and Euxyl K400 [39]. Balsam of Peru is typically found in perfumes, medicines, and flavourings [45]. Lanolin alcohols are a common substance in medicinal and skin care products [46]. Euxyl K400 is a widely used antimicrobial preservative product in cosmetics, topical drugs, and cutting

Table 2 Most frequent allergens in allergic contact dermatitis in the elderly

Fragrance mix
Nickel
Balsam of Peru
Lanolin alcohols
Paraben mix
Diamino diphenylmethane
Quinolone mix
Euxyl K400

fluids [47]. Diamino diphenylmethane is frequently seen in rubber products and elastic bandages [39, 43].

Patients with stasis dermatitis, chronic wounds, and chronic venous insufficiency have an increased prevalence of sensitization due to the frequent exposure to topical treatments. Furthermore, these patients show a damaged skin barrier due to comorbidity, which predisposes them to a more easily achieved sensitization. Chronic wounds are a global health problem that affects 0.3–6% of older people [48, 49]. The sensitization rate increases with the duration of the chronic wounds. Saap et al. analysed the prevalence of contact sensitivity in patients with leg ulcers in North America compared to the North American Contact Dermatitis Group (NACDG) database and European study results [50]. The most common allergens were *Myroxylon pereirae* (balsam of Peru) (30%), bacitracin (24%), fragrance mix (20%), wood tar mix (20%), propylene glycol (14%), neomycin sulphate (13%), benzalkonium chloride (13%), carba mix (11%), nickel sulphate (11%), and control gel hydrocolloid (11%) [50]. A high incidence of positive patch test results in patients with past or present leg ulcers was comparable to other European study results. The incidence of the most common allergens was higher than in the NACDG, except for nickel [50]. Machet et al. evaluated the incidence of sensitization in patients with ulcers between 2001 and 2002 in France [51]. Of 106 patients, 75% had at least one positive reaction and 57% had two or more positive reactions. Balsam of Peru was positive in 40% of the cases, followed by lanolin (21%), fragrance mix (18%), trichlocarban (13%), colophony (11%), Cetavlon® (cetrimide cream) (9%), and neomycin (9%) [51]. Mahler investigated the most common contact allergens in patients over 65 years with comorbidities (stasis dermatitis/ulcus curis and chronic venous insufficiency as cofactors) in Germany [41]. Balsam of Peru (11.9%), fragrance mix I (11.5%), tert-butylhydroquinone (10.1%), Amerchol L 101 (lanolin; 9.0%), fragrance mix II (7.6%), and wool wax alcohols (7.5%) were the most common contact allergens [41].

Another type of ACD is systemic contact dermatitis (SCD), which occurs in a previously sensitized individual after systemic re-exposure to the same or cross-reacting substance [52]. Oral, transmucosal, intravenous, intramuscular, inhalation, and implants are possible systemic routes of exposure [53]. Literature about the prevalence of SCD in elderly patients is missing. Most of the frequently recognized allergens are nickel, aminoglycoside antibiotics, corticosteroids, balsam of Peru, and plants from the families *Anacardiaceae* and *Compositae* [52]. Clinically, the SCD may be characterized by a flare of eczema, vasculitis-like lesions, pompholyx, or baboon syndrome. Baboon syndrome is typically described as the sudden appearance of a generalized eruption localized in the major flexures and the anogenital area [52].

The most important pillar of contact dermatitis therapy is allergen restriction. If the medical history does not already provide a probable trigger, it is advised to not use any topical agents until the follow-up visit, with a new evaluation of the products brought along [54]. Emollients are highly recommended to restore the skin barrier function. However, it must always be considered that the vehicles and additives contained in the therapeutic agent were not present in the suspected product or do not have a cross-reaction. Diagnostic patch tests with potential triggering substances are also indicated for seniors and may include the most frequent allergens in the elderly: fragrance mix, nickel, balsam of Peru, lanolin alcohols, paraben mix, and diamino diphenylmethane. When chronic wounds are present, topical therapy bases and topical therapy ingredients should be considered in epicutaneous testing in addition to the standard series [41]. The efficacy of topical corticosteroids for the management of ACD is widely established [55]. Topical calcineurin inhibitors may be particularly recommended for areas prone to corticosteroid-related atrophy during prolonged use, such as the face and neck.

5 Conclusions

Increasing life expectancy requires improvement in skin care in the elderly. The combination of immunosenescence with typical age-related tissue structure modification predisposes individuals to the development of skin diseases such as contact dermatitis. AID and PICD are common types of ICD in the elderly and require rapid diagnosis and therapy to regenerate the skin barrier and avoid superinfections. ACD is a T-cell-mediated inflammatory reaction and requires prior sensitization. Elderly patients present an increased prevalence of sensitization to fragrance mix, nickel sulphate, as well as topical agents such as balsam of Peru, lanolin alcohols, paraben mix, and diamino diphenylmethane. Epicutaneous testing to identify the allergen and to eliminate the agent is mandatory. The components of topical therapies may also be tested in patients with chronic wounds, since these patients have an increased prevalence of sensitization due to frequent exposure to topical treatments.

Compliance with Ethical Standards

Funding No funding was received for the preparation of this manuscript.

Conflict of interest AL. Lima, V. Timmermann, T. Illing, and P. Elsner declare that they have no conflict of interest.

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