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Case reports

Acrylic sculpting nails, an occupational hazard for contact dermatitis. Case reports and review of the literature

Laura Georgiana Moise[1], Sonia Bădulici[2], Agripina Rașcu[1,2], Alexandra Maria Rașcu[3]

[1] University of Medicine and Pharmacy "Carol Davila", Clinical Department 5, Bucharest, Romania
[2] Occupational Department, Colentina Clinical Hospital, Bucharest, Romania
[3] Doctoral School , "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

Corresponding author
Agripina Rașcu
agrirascu@yahoo.com

Abstract

Acrylates are plastic materials formed by the polymerization of monomers, which are recognized as powerful sensitizers that may cause allergic contact dermatitis both in occupational and non-occupational environment. In the occupational setting, the most exposed workers are the dentists, dental technicians, prosthesis technicians, printers, painters, fiberglass workers and nail technicians. We describe four cases of occupational allergic contact dermatitis in nail technicians caused by acrylic compounds that illustrate numerous clinical manifestations. Clinical manifestations ranged from edema, erythema, scaling and fissuring fingertips to erythematous patches around the chin, mandible and abdomen. Patch testing results revealed positive reaction to 2-hydroxyethyl methacrylate in all patients. Of the four patients, two changed jobs, one stopped exposure because of pregnancy and one patient continued working, showing no improvement, despite undergoing treatment. These cases underline the importance of improvement of preventive measures in the workplace.

Keywords: *allergic contact dermatitis, acrylates, occupational disease, nail technicians*

Introduction

Acrylates and methacrylates are the salts, esters and conjugate bases of acrylic and methacrylic acid and are widely used in various applications in adhesives, glues, varnishes, paints, coating, leather, plastics, textiles, glass substitutes, printing industry, dentistry as filling materials and in artificial acrylic nails. They are plastic materials formed by polymerization of monomers, which are relatively small molecules that bond chemically to form a chainlike molecule called a polymer. The polymerization process may occur spontaneously or upon ultraviolet light (UV) exposure [1]. Monomers are known to be powerful sensitizers and strong irritants, while polymers are significantly weaker or non-sensitizing [2]. (Met)acrylates are recognized as strong allergens and irritants that can cause allergic and irritant contact dermatitis both in occupational and non-occupational environment [3]. In the occupational setting, the most exposed workers are the dentists, dental technicians, prosthesis technicians, printers, painters, fiberglass workers and nail technicians.

However, recently, the number of cases of allergic contact dermatitis (ACD) has increased among nail technicians due to the new trends in manicure and

increased demand from women more focused on the appearance of their fingernails. Here we present four cases of ACD in nail technicians caused by acrylic compounds that illustrate numerous clinical manifestations.

Case reports

A 36-year-old female presented to our Occupational Medicine Clinic for bleeding lesions with crusts and scales on the distal and middle phalanges (Figure 1) of both hands. She was known with no atopic background and personal and family history was unremarkable. She worked as a nail technician for 8 years in the same workplace and in the last year her work involved mainly sculptured acrylic nails and to a lesser extent classic manicure and pedicure. Her colleagues denied having similar symptoms. Patch testing using European Standard Battery, Chemotechnique Diagnostics manufacturer consisted of 32 allergens and 8 allergens from (meth) acrylates series revealed a positive reaction to ethyl methacrylate, 2-Hydroxyethyl methacrylate (HEMA), 1,6 hexanediol diacrylate, trimethylolpropane triacrylate and 2-Hydroxyethyl acrylate (Figure 2, Table 1).

Figure 1. Bleeding lesions with crusts and scales on the hand of case 1

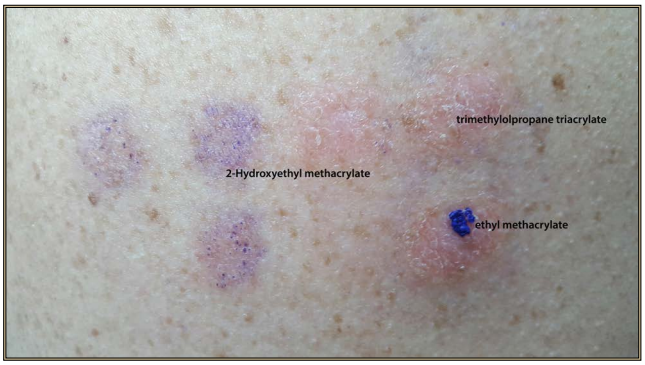

Figure 2. Positive patch test results for case 1

Figure 3. Erythematosus plaque on the upper abdomen of case 2

The second case is a 39-year-old female who worked as a nail technician for 15 years and developed erythema, scaling and fissuring fingernails, bleeding lesions with crusts and scales on both dorsal hands and itchy, erythematosus plaque on the upper abdomen (Figure 3) after 9 months of working with acrylic compounds. Her past medical history revealed allergic rhinitis and tomato and peanuts allergy. Patch testing revelead positive reactions to ethyl methacrylate, butyl methacrylate, etylene glycol dimethacrylate, 2-Hydroxyethyl methacrylate (HEMA), 1,6 hexanediol diacrylate, trimethylolpropane triacrylate and 2-Hydroxyethyl acrylate (Table 1). Extreme positive reaction with intense erythema and coalescing vesicles and bullous reaction was seen for etylene glycol dimethacrylate, 2-hydroxyethyl methacrylate and 2-hydroxyethyl acrylate (Figure 4).

The third case is a 29-year-old female who presented

Table 1. Positive Patch Test results for all cases

Case 1	Case 2	Case 3	Case 4
Ethyl methacrylate 2-Hydroxyethyl methacrylate 1,6 hexanediol diacrylate Trimethylolpropane triacrylate 2-Hydroxyethyl acrylate	Ethyl methacrylate Butyl methacrylate Etylene glycol dimethacrylate 2-Hydroxyethyl methacrylate 1,6 hexanediol diacrylate Trimethylolpropane triacrylate 2-Hydroxyethyl acrylate	2-Hydroxyethyl methacrylate	2-Hydroxyethyl methacrylate Methyl methacrylate

Figure 4. Positive patch test results for case 2

Figure 5. Edema and erythema of the left hand of case 3

Figure 6. Bleeding lesions with crusts and scales on the hand of case 4

with edema, erythema of the hands and erythematous patches around the chin and mandible. She worked as a nail technician for 5 years and developed the cutaneous manifestations after 13 months of exposure. She has a medical history of allergic rhinitis and her mother is known with asthma since childhood. Patch testing showed positive reaction for 2-hydroxyethyl methacrylate.

The forth case is a 45-year-old female who presented with bleeding lesions with crusts and scales on the middle and distal phalanges of both hands that were worse on the right hand (Figure 6) and erythematous papular rash around the neckline and scratching excoriations associated with intense itching sensation. Her medical history was unremarkable, with no atopic diseases. She worked as a nail technician for 6 years and developed the clinical manifestations after 6 months she started working with acrylic gels. The results for Patch testing after 72 hours showed a positive reaction to 2-hydroxyethyl methacrylate and a similar reaction to methyl methacrylate (Table 1). This case was published extensively previously [4].

Table 2. Characteristics of the patients

	Case 1	Case 2	Case 3	Case 4
Age	36 years	39 years	29 years	46 years
Dominant hand	Right	Right	Ambidextrous	Left
Occupation	Nail technician	Nail technician	Nail technician	
Occupational History	8 years	15 years	5 years	6 years
Dermal manifestations	after 10.5 months erythematous patches around the neckline edema, erythema on both hands, especially on the left	after 9 months erythema, scaling and fissuring fingernails bleeding lesions with crusts and scales on both dorsal hands itchy, squamous, erythematosus, plaque on the upper abdomen	after 13 months edema, erythema on the hands erythematous patches around the chin, mandible	after 6 months lesions with crusts and scales on the middle and distal phalanges of both hands (worse on the right hand)
Hand pain	NO	YES	NO	YES
Rhinitis symptoms	NO	YES	YES	YES
Spirometry	Normal values	Normal values	Normal values	Normal values

The characteristics of the patients are shown in Table 2.

All patients were reported and registered as occupational allergic contact dermatitis. Of the four patients, two changed jobs, one stopped exposure because of pregnancy and one patient continued working. The first three patients showed improvement of dermatitis under treatment in the absence of exposure. Patient no. 4 continued working although the initial recommendation of her occupational physician was to avoid exposure and redeploy to a different type of work. In this case, the occupational physician advised the employer to make the appropriate workplace adjustments and the worker to use suitable personal protective equipment. She is currently being treated by the dermatologist, but despite all these measures, she is showing no improvement.

Discussion

There are different varieties of artificial nails that include press on nails (fake nails), acrylic nails, gel nails and shellac nails. The difference between them lies in what they are made of and the way they are cured. Acrylic products may be found in liquid form (the monomer) or the solid form (the powder). In nail products, the liquid form contains the monomer, a cross-linking agent like ethylene glycol dimethacrylate (EGDMA), an inhibitor (hydroquinone) and an activator in order to prevent premature hardening. The powder is the polymer containing polyethylmethacrylate beads, an initiator (benzoyl peroxide) and pigments [5]. The products required for the acrylic nails are two separate products (liquid and powder) that need to be mixed in order to be used. They may harden at room temperature. On the other hand, gel nails and shellac nails are premixed products (monomer and polymer) that are found in the same container and require UV light in order to cure. Even in the case of premixed products, the nail technicians are exposed to a high level of met(acrylates) during the grinding process when residual dust particles come in direct contact with the skin.

In 2012, the American Contact Dermatitis Society nominated acrylates the contact allergen of the year due to their ubiquitous features and wide range of application. Recently, starting with 2019, European Society of Contact Dermatitis has been included 2-hydroxyethyl methacrylate (2-HEMA) in the update of the baseline series due to the new cases emerging caused by nail polish products in which the allergen accounts for 90% of the positive patch skin tests for acrylates performed in the general population [6].

Several studies reported cases of allergic contact dermatitis caused by acrylates and methacrylates in workers from nail salon industry. In 2018, a retrospective study in 11 European Environmental

Contact Dermatitis Research Group (EECDRG) clinics was conducted on 18228 patients tested for ACD caused by nail acrylates. They reported 202 cases of ACD caused by acrylates of which 67,3% were caused by nail acrylates. Most frequently the skin lesions were found on the hands and face. The incriminating allergens were HEMA, hydroxypropyl methacrylate (HPMA), EGDMA and ethyl cyanoacrylate (ECA) [7]. In 2017, Gatica-Ortega et al. reviewed the medical files of 2353 diagnosed patients with ACD that were admitted in four dermatology departments in Spain. They found 43 cases of ACD caused by acrylates, of which 93% were occupational and located on the hands. These patients were sensitized to HPMA and HEMA [8].

After a 3 year longitudinal study, the results of Pestana et al. raised the importance of the registration and reporting of occupational contact dermatitis amongst workers exposed to acrylates. Only 8 cases were reported as occupational contact dermatitis of the total of 27 cases of occupational ACD caused by nail acrylates. After diagnosis, 27.3% abandoned work, 23.4% changed work station and although 49% avoided exposure, 22% of them showed to improvement. The most common positive allergens were HEMA, HPMA, TEGDMA (triethylene glycol dimethacrylate) and EGDMA [9].

The criteria for establishing occupational causation for contact dermatitis may include:

1.Clinical appearance consistent with contact dermatitis
2.Workplace exposure to potential cutaneous irritants or allergens
3.Anatomical distribution consistent with cutaneous exposure related to the job
4.Temporal relationship between exposure and onset consistent with contact dermatitis
5.Non-occupational exposures excluded as likely causes
6.Removal from exposure leads to improvement of dermatitis
7.Patch tests implicate a specific workplace exposure

Several case series of occupational allergic contact dermatitis caused by (met)acrylates were also reported. Clinical manifestations ranged from edema and a well-defined erythema of both eyelids [10], erythema, scaling and fissuring fingertips [11], erythematous dermatitis of the dorsa of the hands, palms, forearms fissures on fingertips [12], redness and oozing skin lesions of the ears and external auditory canals, hand eczema and bullous lesions on fingers [13], episodes of non-pruritic cheilitis and lip edema [14] and nail dystrophy and periungual hyperkeratosis [15].

Skin disorders account for more than 35% of all occupational diseases [16]. This high prevalence requires an improvement of the preventive measures in the workplace. In nail salons, efficient ventilation methods and protective equipment such as face masks, suitable clothing to cover exposed areas and gloves are recommended. Acrylates, latex, vinyl and polyethylene are able to penetrate almost all types of rubber products; therefore, this protective equipment is of no benefit and should not be used [17]. Studies have shown that polyethylene or ethylene vinyl alcohol gloves are the most efficacious, followed by nitrile gloves; the rigidity of polyethylene or ethylene vinyl alcohol gloves hampers the tasks that require meticulosity such as of nail technicians. Therefore, the American Contact Dermatitis Society recommends having two layers of nitrile gloves or polyethylene gloves under nitrile gloves for a 30 to 60 minutes of efficient protection [18].

Registration and reporting occupational contact dermatitis is an important source of information for preventive policy. Not knowing the size of the problem, public health officials cannot plan intervention programmes or allocate resources. For workers to receive compensation, therapy or prevention we have to officially recognize their condition as an occupational disease and report it. ACD remains an important cause of work disability and decreased productivity that impacts both worker and society.

Conclusion

Allergic contact dermatitis is more difficult to manage compared to the irritant form that is dose dependent. Once sensitized, the patient reacts even in the presence of small amounts of allergen. The complete elimination of the allergen is not always possible, which is why the most effective treatment for these patients is to avoid exposure.

Therefore, an effective medicine means treating the underlying cause, in many cases that being more important than treating the consequences of the disease. As such, we need to recognize the risk, identify the risk factors using a thorough investigation and implement and respect the recommendation of appropriate preventive measures.

Occupational allergic contact dermatitis is an important public health problem thus a close

cooperation between occupational physician, dermatologist and other healthcare specialists is required in order to ensure overall welfare.

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