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ORIGINAL ARTICLE

Contact Dermatitis Caused by Acrylates Among 8 Workers in an Elevator Factory

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KEYWORDS

Acrylates;
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PALABRAS CLAVE

Acrilatos;
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Abstract

Introduction: Acrylates are widely used low-molecular-weight substances, initially introduced in industry in the 1930s and subsequently applied also in medicine and the home. One of their main features is the ability to undergo polymerization. The most commonly used acrylic compounds are cyanoacrylates, methacrylates, and acrylates.

Objective: To confirm suspicion of occupational disease in a group of workers in an elevator factory.

Material and methods: We studied 8 patients with dermatitis of the hands and finger pads. In their work, the patients came into contact with acrylates. Patch testing was applied with an acrylate panel (BIAL-Arístegui, Bilbao, Spain).

Results: Seven of the patients (87.5%) had a positive result with 1% ethylene glycol dimethacrylate. Positive results were also observed for 2% hydroxyethyl methacrylate (5 patients, 62.5%), 1% triethylene glycol dimethacrylate (4 patients, 50%), 10% ethyl methacrylate monomer (3 patients, 37.5%), 10% methyl methacrylate monomer (2 patients, 25%), 1% ethyl acrylate (1 patient, 12.5%), and 0.1% acrylic acid (1 patient, 12.5%)

Conclusions: We highlight the strong sensitizing capacity of acrylates and the importance of taking all necessary preventive measures in industries where these substances are used. Such measures should include avoidance of contact with the product in cases where sensitization has been confirmed.

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Dermatitis de contacto a acrilatos en una industria de fabricación de ascensores. A propósito de 8 casos

Resumen

Introducción: Los acrilatos son sustancias químicas de bajo peso molecular, con una amplia utilización en la industria (desde su introducción en los años treinta), la medicina y el

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Dermatitis irritativa de contacto

medio doméstico, que destacan por sus propiedades de polimerización. Los compuestos acrílicos más utilizados son los cianoacrilatos, los metacrilatos y los acrilatos.

Objetivo: Establecer el diagnóstico de sospecha de enfermedad profesional en un grupo de trabajadores de una fábrica de ascensores.

Material y métodos: Se estudian un total de 8 pacientes que presentan clínica de dermatitis en las manos, así como pulpitis en los dedos, y que trabajan en contacto con acrilatos. Se realizaron pruebas epicutáneas con batería de acrilatos (BIAL-Aristegui, Bilbao, España).

Resultados: El 87,5% mostró positividad frente al dimetacrilato de etilenglicol al 1%. También mostraron positividad el hidroxietilmetacrilato al 2% (62,5%), el dimetacrilato de trietilenglicol al 1% (50%), el monómero de metil metacrilato al 10% (25%) y el monómero de etil metacrilato al 10% (37,5%), el acrilato de etilo al 1% (12,5%) y el ácido acrílico al 0,1% (12,5%).

Conclusiones: Destacamos el alto poder sensibilizante de los acrilatos y la importancia de extremar las medidas preventivas en las distintas industrias, así como la evitación del contacto con el producto en los casos de sensibilización demostrada.

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Introduction

Acrylates are widely used low-molecular-weight substances, initially introduced in industry in the 1930s and subsequently applied in medicine and the home. One of their main features is the ability to polymerize. The most commonly used acrylic compounds are cyanoacrylates, methacrylates, and acrylates.

Cyanoacrylates are also known as “superglues.” Cyanoacrylate-based glues are widely used as contact adhesives for metal, glass, rubber, plastic, and fabrics. They are also used with biological materials, for instance in acrylic cements used to fix bone prostheses and in dressings for surgical wounds.

Although acrylates can cause cutaneous and mucosal irritation at specific concentrations, they have also been shown to cause contact dermatitis and occupational asthma. Cases of contact dermatitis caused by acrylic compounds have been reported since the 1940s; cases of rhinoconjunctivitis, asthma, and even contact urticaria have been reported since 1985.¹

In recent years, there has been an increase in the incidence of allergic contact dermatitis caused by acrylates in porcelain and sculptured nails. This condition mainly affects professional beauticians, who handle these products, although it has also been observed in women who use them at home.²

Reports of sensitization to acrylates used in the manufacture of microprocessors and in related industries are less frequent.³

The objective of our study was to confirm suspicion of occupational disease in a group of workers in an elevator factory.

Material and Methods

Patients were studied at the Occupational Disease Study Center of the Asepeyo Cartuja-Occupational Health Institute in Seville, Spain.

We studied a series of patients exposed to products used daily in the workplace. These included the anaerobic glue SELON 631 (Wilneder GMBH, Geislingen, Germany), which is composed of hydroxyethyl methacrylate.

The study included all patients attending the emergency department of our institution with dermatitis on their hands (Figure 1) that appeared to be linked to the workplace. We also examined all other workers from the same department who had similar symptoms but who did not attend the emergency department.

We saw a total of 8 patients who together made up the elevator motor manufacturing section of the company.

All the patients underwent patch testing with the commercial True Test panel (Mekos Laboratories, Hillerod, Denmark) and an acrylate panel (BIAL-Aristegui, Bilbao, Spain). The acrylate panel remained unchanged throughout the study period. The test discs were prepared on adhesive Curatest strips (Lohmann & Rauscher International, Germany) and remained on the patient's back for 48 hours.



Figure 1 Contact dermatitis lesions caused by acrylates.

Test results were read at 48 and 96 hours, according to the criteria of the International Contact Dermatitis Research Group (+, ++, +++). The results of patch testing were considered to have present relevance if symptoms could be attributed to handling of or contact with substances containing the acrylates tested.

Results

Patients

The study sample comprised 8 patients who, over the previous few months, had presented cutaneous lesions on their hands, mainly on the pads of the thumb, index finger, and ring finger. The lesions took the form of fissures,

erythema, and desquamation, which were occasionally accompanied by intense pruritus and a burning pain (Table).

All of the patients worked in the motor assembly section of a factory that manufactured elevators and escalators. In their work, they used black rubber, chrome screws and plates (Figure 2), and single-component anaerobic adhesive (SELON 631).

The study procedure is described below.

Patch Tests

Patch tests were performed using the standard panel recommended by the Spanish Contact Dermatitis Group, namely, the True Test panel (Mekos Laboratories, Hillerod, Denmark). All results were negative, as were

Table Patients Studied

| Age, y | Sex | Acrylate Panel | Mode of Sensitization | Latency | Location |
|--------|------|----------------------|-----------------------|---------|--|
| 60 | Male | 1, 3, 4, 5, 6, 8, 10 | Occupational | 1 mo | 1st and 2nd fingers of both hands |
| 45 | Male | 1, 3, 4, 5, 6 | Occupational | 4 mo | 2nd and 3rd fingers of the right hand and 1st and 2nd fingers of the left hand |
| 29 | Male | 4, 6 | Occupational | 1 mo | 1st, 2nd, and 3rd fingers of both hands |
| 38 | Male | Negative | Occupational | 2 mo | Pad of the 2nd finger of both hands and both dorsa |
| 55 | Male | 6 | Occupational | 2 mo | Pad of the 2nd finger of both hands and both dorsa |
| 37 | Male | 1, 4, 5, 6 | Occupational | 1 mo | 2nd finger of the left hand |
| 33 | Male | 6 | Occupational | 3 mo | Pad of the 1st and 2nd fingers of the right hand |
| 33 | Male | 1, 4, 6 | Occupational | 1 mo | Pad of the 1st and 2nd fingers of the right hand |

All allergens in petrolatum. 1, 1% triethylene glycol dimethacrylate; 2, 10%, methyl methacrylate polymer; 3, 10% methyl methacrylate monomer; 4, 2% hydroxyethyl methacrylate; 5, 10% ethyl methacrylate monomer; 6, 1% ethylene glycol dimethacrylate; 7, 0.1% acryl nitril; 8, 1% ethyl acrylate; 9, 0.1% methacrylic acid; 10, 0.1% acrylic acid.



Figure 2 Materials used by the workers.

those of patch testing with 2 types of gloves used in the workplace.

The results of patch testing with the acrylate panel (BIAL-Aristegui, Bilbao, Spain) were positive (Table).

Discussion

The 8 patients who had lesions on their hands worked in the same company in the section where the elevator motors were assembled. None of the other factory employees had lesions. One of the workers, whose test result was negative, only had erythema on the finger pads accompanied by intense pruritus with no other lesions.

Assessment of the components the patients used in their work led to immediate suspicion of sensitization to black rubber, epoxy resin, mercaptobenzothiazole, or thiuram mix. The negative results of the tests and the responses to exhaustive questioning about the individual tasks the patients performed and the way they were performed led us to suspect SELON 631. This product is used to seal the screws of the motor to prevent them from loosening. The safety instructions were consulted and patch testing with acrylates was performed.

Ethylene glycol dimethacrylate is a highly irritant substance that causes sensitization on contact with the skin. The latency period for sensitization to this product varies from 1 month to several years. Ethylene glycol dimethacrylate in particular only requires a short exposure period before symptoms appear; therefore, the strictest precautions must be taken when handling the product. Although the workers wore gloves when handling the product, consultation of the safety instructions revealed that the patients did not take the recommended preventive measures: they did not wear protective goggles or use gloves that were suitable for the composition of the product, and they did not apply a protective barrier cream.

Allergic contact dermatitis to acrylates was first reported with methyl methacrylate in 1941.⁴ Since then, acrylate-induced dermatitis has been associated with working in the printing and cosmetic industries.⁵ In hospitals, orthopedic surgery is an increasingly common source of exposure to acrylates.⁶⁻⁸ There are no reports of sensitization to acrylates in the metal industry, although cases of dermatitis in the workplace with no clear occupational trigger are not uncommon. Such cases often involve sensitization to substances outside the workplace arising from individual susceptibility (genetic predisposition). Occasionally, irritant contact dermatitis can become chronic due to the lack of appropriate industrial hygiene measures; hence the importance of good collaboration between occupational health physicians, allergy specialists, dermatologists, and experts in prevention.⁹

Not all of the patients we report were sensitized to the component of the glue used in their workplace (hydroxyethyl methacrylate). However, all those who were sensitized to the product were also sensitized to ethylene glycol dimethacrylate. Therefore, we may be observing cross-reactivity between the compounds. Given the widespread use of glues containing these substances in the home, it is important to bear this possibility in mind.

We must always remember that subclinical sensitization in the home could lead to allergic contact dermatitis years later in the workplace, with the financial and occupational consequences this implies for companies and workers.

It is also necessary to take into account the irritation that can be triggered by acrylates, considering that one of the patients was not sensitized to any of them, despite presenting pruritus on contact.

Acrylate-induced contact dermatitis usually manifests as chronic eczema of the fingers and hands; it can lead to occupational disability, as these resins can pass through plastic and rubber gloves (vinyl and nitrile).¹⁰ Therefore, in cases of sensitization to acrylates, the only possible preventive measure is to move the patient from the work area (ie, out of contact with the product) and to ensure adequate implementation of safety measures during subsequent exposure with other workers.

Previous reports in similar companies involved the affected workers being removed from their work area to allow symptoms to resolve.³

Another option would require the glue to be replaced by one that does not contain acrylates once the cutaneous lesions have completely resolved, since the irritant nature of the product causes considerable atrophy, which in turn produces fissures, with the known risk of infections and pain.

Perhaps the most efficient solution would be the use of self-locking screws that do not require subsequent sealing to be fixed, thus completely avoiding contact with the irritant without having to move workers from their areas.

The personal safety recommendations for these products should be followed to prevent sensitization. Workers should use alcohol-resistant gloves made of polyethylene, natural rubber, or a similar material. It is also important to remember to replace gloves regularly, especially after intense contact with acrylates. A protective barrier cream should also be applied underneath the gloves in order to ensure maximum protection in case the gloves are damaged with use. Protective goggles should also be worn.

Different affinities of class II human leukocyte antigen molecules have been observed. On the one hand, they have been reported to be a predisposing factor in workplace studies,¹¹⁻²⁰ and even specific alleles such as DQB*0501 have been shown to confer susceptibility to develop an immunoglobulin E-based allergic response to organic acid anhydrides¹⁵; on the other hand, they act as a protective factor against low-molecular-weight allergens.^{12,16,18} These differences arise because expression of the genotype depends on the patient's context.^{21,22}

Consequently, control of the working environment is increasingly important: measures should be correctly applied to prevent the development of occupational diseases related to these products.

Conclusions

We wish to stress the importance of preventive measures in controlling occupational diseases. We also highlight the investigative work required of the physician in order to reach a specific diagnosis and to identify the allergen.

Close cooperation between specialists, occupational health physicians, and experts in prevention is paramount.

Conflicts of Interest

The authors declare no conflicts of interest.

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