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Contact allergy to acrylate-containing nail cosmetics: A retrospective 8-year study

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Abstract

Background: Over the last 10 years, allergic contact dermatitis (ACD) from acrylate-containing nail cosmetics (acrylic nails, gel nails, gel nail polish) has been reported repeatedly.

Objectives: To investigate the frequency and clinical features of ACD in nail cosmetics in a university hospital in Amsterdam, The Netherlands.

Patients and Methods: A retrospective study in patients diagnosed with ACD from acrylate-containing nail cosmetics at the Amsterdam University Medical Centers between January 2015 and August 2023.

Results: Sixty-seven patients, all women, were diagnosed with ACD from nail cosmetics, representing 1.6% of all individuals and 2.3% of all women patch tested in this period. Sixty-five of sixty-seven (97%) subjects had a positive patch test to 2-hydroxyethyl methacrylate (HEMA). Forty-nine patients (73%) were consumers and 18 (27%) were professional nail stylists. The sites most frequently affected with dermatitis were the fingers (79%), hands (40%) and the head and/or neck. Avoidance of contact with acrylate-containing products resulted in complete clearing of dermatitis in 80% of patients.

Conclusions: ACD from acrylate-containing nail cosmetics is frequent in women patch tested in Amsterdam. Nearly all were identified by a positive patch test to 2-hydroxyethyl methacrylate in the (meth)acrylate series or the European baseline series.

KEYWORDS

2-hydroxyethyl methacrylate, acrylates, acrylic nail, allergic contact dermatitis, contact allergy, gel nail, gel nail polish, HEMA, methacrylates, nail cosmetics

1 | INTRODUCTION

During the last 10 years, allergic contact dermatitis (ACD) from acrylate-containing nail cosmetics such as acrylic nails, gel nails and gel nail polish has been reported in several publications, mostly originating from Europe[1–8] and some from other countries.[9,10] Both consumers and professional nail technicians (nail stylists) may be affected, causing occupational ACD in the latter group. Especially in the southern countries of Europe, ACD in professionals is more frequent than dermatitis in consumers.[1,2,4,7,8]

There are no reports on the subject of ACD to nail cosmetics from The Netherlands, which prompted us to study the available data

in the Amsterdam University Medical Centers, the largest tertiary referral centre for (occupational) contact dermatitis in this country.

2 | MATERIALS AND METHODS

Information of all patients diagnosed at the Amsterdam UMC with ACD from acrylate-containing nail cosmetics between 12 January 2015 and 15 August 2023 was retrieved from the patch test database and electronic patient files. From 2015 to June 2019, patients suspected of contact allergy to (meth)acrylates in nail cosmetics or other products were tested with the European baseline series supplemented with a (meth)acrylates series containing 12 methacrylates and 2 acrylates (Table 1). On 11 June 2019, 2-hydroxyethyl methacrylate (HEMA) 2% pet. was added to the baseline series tested in all patients suspected of contact dermatitis.

Information on sex, age, type of exposure (consumer, professional nail stylist *without* personal use of nail cosmetics, nail stylist *with* personal use), type of nail cosmetics used/contacted, localisation of dermatitis, and patch test results was analysed.

The commercial test haptens used were obtained from Allergeaze (SmartPracticeCanada, Calgary, Canada) and from Chemotechnique Diagnostics (Vellinge, Sweden). Patch testing was performed with Van der Bend patch test chambers® (Van der Bend, Brielle, The Netherlands), fixation with Omnifix® elastic (Paul Hartmann BV, Nijmegen, The Netherlands). The occlusion time was 48 h, and the results were read at day 2 (D2) with a second reading on D3 or D4 according to ESCD criteria.[11] Patients were instructed to contact the department when new reactions were observed after the final reading. Statistical analyses were performed using the two-tailed two-sample *t*-test assuming unequal variances and the chi-square test with a significance level of 0.05.

3 | RESULTS

In a period of 8.5 years, 67 patients were diagnosed with ACD from nail cosmetics. The numbers of allergic patients by year were 3 (2015), 2 (2016), 8 (2017), 4 (2018), 6 (2019), 8 (2020), 10 (2021), 16 (2022) and 10 (2023; 7 months). All were women, and their ages ranged from 14 to 69 years (mean 41, median 42). Twenty-one of the 67 patients had been identified by positive patch tests in the (meth)acrylates series tested between January 2015 and June 2019, and 29 by positive patch tests to HEMA in the baseline series and to one or more haptens in the methacrylate series between June 2019 and August 2023. The remaining 17 patients had been identified by a positive reaction to HEMA in the baseline series only; in these individuals, the (meth)acrylate series had not been tested. The 46 patients identified in the period that HEMA was tested in the baseline series represented 1.6% of all individuals patch-tested in that period ($n = 2921$) and 2.3% of all women ($n = 2015$).

Of the 67 patients allergic to nail cosmetics, 65 (97%) had shown a positive patch test reaction to HEMA. The results of patch tests in the 50 women who had been tested with the (meth)acrylate series are shown in Table 1.

TABLE 1 Positive (meth)acrylate patch test reactions among 50 patients with ACD from nail cosmetics tested with the (meth)acrylates series.

Hapten	Positive reactions *n* (%)
2-Hydroxyethyl methacrylate (HEMA) 2%	48 (96%)
Hydroxypropyl methacrylate 2%	46 (92%)
Ethylene glycol dimethacrylate 2%	42 (84%)
1,4-Butanediol dimethacrylate 2%	35 (70%)
Tetrahydrofurfuryl methacrylate 2%	34 (68%)
Urethane dimethacrylate 2%	30 (60%)
Triethylene glycol dimethacrylate 2%	27 (54%)
Methyl methacrylate 2%	23 (46%)
Dimethylaminoethyl methacrylate 0.2%	13 (26%)
1,6-Hexanediol diacrylate 0.1%	11 (22%)
Butyl methacrylate 2%	10 (20%)
Bisphenol A glycerolate dimethacrylate (BIS-GMA) 2%	3 (6%)
Epoxy acrylate 0.5%	3 (6%)
Bisphenol A dimethacrylate (BIS-MA) 2%	2 (4%)

Note: All allergens in petrolatum.

Of the total of 67 individuals with ACD from nail cosmetics, 49 (73%) were consumers and 18 (27%) were professional nail stylists, of whom 9 also applied acrylate-containing nail cosmetics on themselves. Nail products used by the patients were acrylic nails ($n = 29$), gel nail polish ($n = 30$), gel nails ($n = 20$) and polygel ($n = 4$); 6 products were insufficiently specified ('fake nails', 'artificial nails') and 3 unknown. Thirty-five of the 49 consumers and 7 of the 18 professionals had used only one product type, which had caused the ACD: acrylic nails ($n = 17$), gel nail polish ($n = 18$) and gel nails ($n = 7$).

In eight consumers for whom relevant information was available, the time between first contact with nail cosmetics and the first symptoms of contact allergy ranged from 0 to 108 months (median 21, mean 34). In five of nine nail professionals who *did not* use nail cosmetics themselves, the corresponding data were 8–54 months (median 18, mean 24). For seven of nine professionals who *did* use nail cosmetics themselves, data was 6–48 months (median 18, mean 24). There was no statistically significant difference in the time between first contact with nail cosmetics and the first symptoms of contact allergy between the professionals who did not use nail cosmetics themselves and those who did ($p = 0.97$). Neither was there a significant difference between consumers and professionals ($p = 0.48$).

All patients had shown dermatitis related to the use of nail cosmetics, either at the time of consultation ($n = 41$, 61%) or previously ($n = 26$, 39%). The locations of dermatitis in the patients are shown in Table 2. The sites most frequently affected were the fingers (79%), the hands (40%) and head and/or neck (29%). There were no statistically significant differences between the groups of

TABLE 2 Clinical characteristics of ACD, stratified by mode of exposure to nail cosmetics.

	Consumers ($N = 45$)	Professional use ($N = 8$)	Professional + consumer use ($N = 9$)	All patients ($N = 62$)
Sites of dermatitis	***n*** **(%)**	***n*** **(%)**	***n*** **(%)**	***n*** **(%)**
Finger	37 (82%)	5 (63%)	7 (78%)	49 (79%)
Hand	16 (36%)	4 (50%)	5 (56%)	25 (40%)
Arm	2 (4.4%)	2 (25%)	1 (11%)	5 (8%)
Head and/or neck	12 (27%)	4 (50%)	2 (22%)	18 (29%)
Periocular	6 (13%)	1 (13%)	–	7 (11%)
Other	6 (13%)	1 (13%)		7 (11%)

Note: Data missing $N = 5$ (7.5%).

consumers, professionals and professionals who were also consumers.

Eight patients (12%) had developed nail disorders from using nail cosmetics, 10 individuals (15%) complained of paresthesia and 1 had suffered airway symptoms related to exposure to cosmetic nail products.

Follow-up data were available for 42 patients, 31 consumers and 11 professionals. Twenty-eight of the 31 consumers discontinued the use of nail cosmetics. At follow-up, 23 of these (82%) were free of dermatitis. Seven of 11 professionals discontinued working with nail cosmetics. In five of them (71%), the eczema had disappeared completely at follow-up.

4 | DISCUSSION

This study shows that, at the Amsterdam UMC, many female patients are diagnosed with allergic reactions to acrylate-containing nail cosmetics. In an 8.5-year period, 67 women with ACD to such products were seen, which appears to be the second largest single-centre group reported thus far after a study from Athens.[8] The group represented 2.3% of all female patients patch-tested in the study period. In similar studies, the corresponding figures were 1.1% (EECDRG, 2013–2015)[1] and 2.8% (Spain, four centres, 2013–2016).[4] Of *all* patients patch tested (men + women), 1.6% had ACD from nail cosmetics. Corresponding data in other studies were 1.7% (Greece, 1 centre, 2009–2018),[8] 1.8%,[4] 2% (Portugal, 13 centres, 2011–2015)[2] and 2.3% (Spain, 3 centres, 2008–2017).[7]

In our study, there was an increase in yearly patient numbers from 2020 on, which may partly be explained by the addition of HEMA to the European baseline series in 2019, which facilitated the identification of these patients. Increasing awareness of the problem and gained experience may also have played a role, but increasing numbers over time have also been observed in many other studies.[8,14]

Most of our patients (73%) were consumers (who either had their nails done by a professional nail stylist or had performed the procedure themselves at home), a minority (27%) were professional nail stylists, which is in line with data from most northern European countries. In the south of Europe, however, there is always a majority of patients who are nail stylists, for example, in Portugal 79%[1] and 76%,[2] in Spain 83%[7] and 93%[4] and 94% in Greece.[8]

A possible explanation could be that in these countries, by far most procedures are performed by professionals, taking great care of not sensitising their clients. In the northern countries, possibly, more women apply these products to themselves at home, which entails a greater risk of sensitization. Self-application of nail cosmetics in nail stylists could also enhance the risk of sensitization, but the percentage of nail stylists doing this is generally not higher in Portugal and Spain (51%,[1] 58%,[4] 16%[7] and 68%[2]) than in The Netherlands (50%, this study, only data available).

In nail technicians, the average time before symptoms developed after they had started to work in the profession was 24 months and for consumers 34 months. In some studies, most nail technicians became sensitised within a year,[1,4,6] whereas in two studies from Spain, a mean latency period of 25 months for nail technicians[2] and 42 months[7] for all sensitised women have been observed.

In our study, the most frequent positive patch test reactions in patients tested with the (meth)acrylate series were HEMA, hydroxypropyl methacrylate and ethylene glycol dimethacrylate. These were also the Top-3 in many other studies on sensitisation to nail cosmetics.[1–3,6,7,9] HEMA was positive in 97% (this study), 100%,[3] 100%,[9] 97%,[7] 95%,[4] 93%,[1] 90%,[2] and 63%,[6] and is therefore a good to excellent screening agent for patients with allergic reactions to nail cosmetics.[12] However, their actual presence in the culprit nail products has been ascertained infrequently.[5] Nevertheless, HEMA may indeed be an important allergen in nail cosmetics, as some recent data suggest that nearly 60% of such products may contain HEMA.[13] A full review of contact allergy to and other aspects of HEMA was recently published in this journal.[12,14]

Contact allergy to acrylate-containing nail cosmetics can have serious consequences for patients, which may not be limited to problems with or being unable to work as a nail technician or experiencing dermatitis or nail disorders from using nail cosmetics. Individuals who acquire contact allergy to (meth)acrylates in nail cosmetics may subsequently also develop allergic reactions from dental materials, knee prostheses, sanitary napkins, glucose sensors and very likely other materials and products.[15]

Several investigators, therefore, have made a plea for stricter regulation of these products to prevent this avoidable problem generated in the pursuit of fashion.[2,4,6,16] In response to the large numbers of patients with contact allergy to HEMA in nail cosmetics and dermatologists' calls to action, in November 2020, in the European Union, the

use of HEMA and di-HEMA trimethylhexyl dicarbamate (di-HEMA TMHDC) in nail cosmetics was restricted in the context of the EU Cosmetics Regulation (EC 1223/2009), permitting only professional use. The warnings 'for professional use only' and 'can cause an allergic reaction' must be stated on the package of nail products containing HEMA, di-HEMA TMHDC or both.[17] However, it was recently shown that these mandatory warnings were absent in 35%–55% of a sample of nail cosmetics which could be purchased online. In addition, the products that were labelled correctly, and are therefore intended for professionals only can be bought online by consumers without any restrictions.[13] We have brought the latter observation (products for professionals are purchased by consumers) to the attention of the competent authority, The Netherlands Food and Consumers Product Safety Authority, but we have been informed that the authorities have no legal possibility to intervene.

5 | LIMITATIONS

The limitations of this study include its retrospective design, selection of patients investigated in a tertiary referral centre and some data not being complete.

AUTHOR CONTRIBUTIONS

Iemke M. Steunebrink: Conceptualization; methodology; data curation; investigation; writing – original draft; writing – review and editing; formal analysis. **Anton de Groot:** Conceptualization; supervision; visualization; methodology; project administration; writing – original draft; writing – review and editing. **Thomas Rustemeyer:** Supervision; resources; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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