Received: 8 November 2023 | Accepted: 9 December 2023

DOI: 10.1111/cod.14488

ORIGINAL ARTICLE

CONTACT DERMATITIS WILEY

Results of patch testing 2-hydroxyethyl methacrylate (HEMA) in the European baseline series: A 4-year retrospective study

Gizem Kocabas[1] | Iemke M. Steunebrink[1] | Anton de Groot[2] | Thomas Rustemeyer[2]

[1]Amsterdam University Medical Centers, Amsterdam, The Netherlands

[2]Dermato-Allergology and Occupational Dermatology, Amsterdam University Medical Centers, Amsterdam, The Netherlands

Correspondence
Anton de Groot, Dermato-Allergology and Occupational Dermatology, Amsterdam University Medical Centers, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands.
Email: antondegroot@planet.nl

Abstract

Background: 2-Hydroxyethyl methacrylate (HEMA) was added to the European baseline series (EBS) in 2019. Few recent data are available on the frequency and relevance of positive reactions to this hapten.

Objectives: To investigate the frequency and relevance of positive patch tests to HEMA in the EBS in a university hospital in Amsterdam, The Netherlands.

Patients and Methods: Retrospective study in patients with positive patch tests to HEMA investigated between June 2019 and August 2023.

Results: Of 2927 consecutive patients, 88 (79 women and 9 men; 3.0%) had a positive reaction to HEMA. The prevalence in women was 3.9%, in men 1.0%. Forty-three (49%) reactions were judged to be of current clinical relevance and 21 (24%) of past relevance. In this group of 64 patients with relevant reactions, 18 (28%) had occupational contact with (meth)acrylate-containing products, of who 11 (61%) were nail stylists. In 46 patients with non-occupational allergic contact dermatitis, 31 (67%) had allergic reactions to nail cosmetics. Glues and glue-containing products accounted for 22% of the materials causing allergic contact dermatitis and dental products for 8%.

Conclusions: Allergic reactions to HEMA are very frequent in women investigated in Amsterdam. Nearly two thirds of cases were caused by nail cosmetics.

KEYWORDS

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

1 | INTRODUCTION

In the last 10 years, 2-hydroxyethyl methacrylate (HEMA) has increasingly been recognized as an important cause of allergic contact dermatitis, especially in women using (consumers) and applying (nail stylists) acrylate-containing nail cosmetics such acrylic nails, gel nails and long-lasting nail polish.[1–3] The rising importance of HEMA was well noted and, therefore, in January 2019, the European Society of Contact Dermatitis included HEMA 2% pet. in the European baseline series (EBS) for routine testing.[4] Soon thereafter, a multicentre study in 13 European countries found a rate of 2.3% positive reactions in 7675 patients suspected of contact dermatitis tested with HEMA in the EBS.[5] Up to now, no studies appear to have investigated the prevalence of positive patch test reactions to HEMA, their relevance and sources of contact (products causing allergic contact dermatitis)

by testing the EBS. The study presented here examines these data in a cohort of individuals patch tested at the Amsterdam University Medical Centers (Amsterdam UMC) between 2019 and 2023.

2 | MATERIALS AND METHODS

Information of all patients who had positive patch tests to HEMA 2% pet. in the EBS at the Amsterdam UMC between 11 June 2019 and 21 August 2023 was retrieved from the patch test database and electronic patient files. Data included sex, age, patch test results, clinical relevance of the reactions (current, past and unknown), current and past professions and products responsible for allergic contact dermatitis. The commercial test haptens used were obtained from Allergeaze (SmartPracticeCanada, Calgary, Canada). 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 on Day (D)2 with a second reading on D3 or D4 according to ESCD criteria.[6] Patients were instructed to contact the department when new reactions were observed after the final reading.

3 | RESULTS

In the study period of 4 years and 2 months, 2927 consecutive patients were patch tested with HEMA in the EBS, of whom 2018 (69%) were women and 909 (31%) were men. A total of 88 positive reactions to HEMA (3.0%) were observed, 79 in women and 9 in men. The prevalence among female patients was 79/2018 (3.9%) and 9/909 (1.0%) among male patients. In sensitized women, the median age was 46 years (range 14–83 years) versus 45 years (range 2–90 years) in non-sensitized patients.

The maximum strength of the patch test reactions for the HEMA-positive patients was + in 66 (75.0%), ++ in 18 (20.5%) and +++ in 4 (4.5%). The numbers of positive reactions by year were 7 (2019, 6.5 months), 17 (2020), 14 (2021), 35 (2022) and 15 (2023, 7.5 months).

Among the 88 HEMA-sensitized individuals, 43 (49%) reactions were judged to be of current clinical relevance, while 21 (24%) were of past relevance; for 24 patients (27%), no relevance was found. In the group of 64 patients with relevant reactions, 18 (16 women, 2 men; 28%) had occupational contact with (meth)acrylate-containing products. Eleven (61%) were nail stylists, of whom 3 also performed eyelash extensions. One was a beautician sensitized to eyelash extension glue. Two dental nurses and one dental technician had occupational allergic contact dermatitis from dental products, two factory workers were sensitized to glues and a laboratory technician had contact with various (meth)acrylates (Table 1).

Of the 46 patients with non-occupational contact allergy to HEMA, 31 (67%) had suffered ACD from nail cosmetics. The other culprit products are specified in Table 1. Glues and dental materials were the second and third most frequent products implicated with five and four reactions, respectively. However, when glues and other products containing an adhesive layer (transcutaneous electrical nerve stimulation [TENS] electrodes, electrocardiogram [ECG] electrodes and medical adhesives), are taken together, the total number of products is 11, representing 22% of all products.

Five patients who were sensitized by nail cosmetics later reacted to other sources of (meth)acrylates. One of the nail stylists suffered a severe reaction to dental fillings with swollen tongue, lips and throat, shortness of breath and a large number of vesicles/erosions in the oral mucosa. Two other women developed intraoral symptoms after dental treatments, of whom one had 10 such episodes. The fourth patient, primarily sensitized to nail cosmetics, later suffered ACD from TENS-electrodes and adhesive tapes. The fifth was a dental nurse who had been sensitized by nail cosmetics and developed hand dermatitis after starting her work in the dental practice.

TABLE 1 Sources of contact with (meth)acrylate-containing materials.

Sources of contact	Nr. of patients	(%)
Sources in 18 patients with occupational exposure		
Nail cosmetics	11	(52.4%)
Eyelash extension glues	4	(19.0%)
Dental materials	3	(14.3%)
Industrial glues	2	(9.5%)
Various (meth)acrylate chemicals	1	(4.8%)
Total	21[a]	(100%)
Sources in 46 patients without occupational exposure		
Nail cosmetics	31	(62%)
Glues (including 3× eyelash extension glues)[b]	5	(10%)
Dental materials	4	(8%)
TENS electrodes[b]	4	(8%)
Hearing aids	2	(4%)
Hygiene pads	2	(4%)
Medical adhesives[b]	1	(2%)
ECG electrodes[b]	1	(2%)
Total	50[c]	(100%)

Abbreviations: ECG, electrocardiogram; TENS, transcutaneous electrical nerve stimulation.
[a]The total number of products ($n = 21$) exceeds the number of patients ($n = 18$), as three nail stylists had contact with both nail products and eyelash extension glues.
[b]The total number of glues + products with an adhesive layer is 11 (22% of the total number of products).
[c]The total number of products ($n = 50$) exceeds the number of patients ($n = 46$), as some had contact with more than one (meth)acrylate-containing product.

4 | DISCUSSION

This study shows that the addition of HEMA to the EBS in 2019 was well-justified, at least for The Netherlands, both in terms of the overall frequency of sensitization (in the total patch test population 3.0%, among women 3.9%) and the number of clinically relevant reactions (73%). There appears to be only one other study reporting the frequency of positive patch tests to HEMA in the EBS.[5] In this study in 13 European countries, of 7675 patients patch tested in 2019 and 2020, 178 (2.3%) had positive reactions to HEMA (HEMA was part of the EBS in 9 of the 13 countries). The prevalences ranged from 0.9% in Hungary to 4.4% in Finland (only 90 patients tested, occupational clinic). Almost three fourths of the patients were tested in three countries, where prevalences were 1.8% (Spain), 1.6% (Italy) and 2.5% (United Kingdom). No data on the frequency in the subgroup of women, the relevance of the reactions and sources of contact with HEMA or other (meth)acrylates were provided.[5]

However, in addition to this report, recent results (from 2016 on) of routine testing with HEMA *before HEMA was included in the EBS* are available from several European countries. Rates of positive reactions to HEMA were 1.7% in the UK in 2016–2017,[7] 1.5% in Italy in 2016–2018 (2.5% in women, 0.5% in men),[8] 1.6% in Italy in 2018 (2.4% in women),[9] 2.4% in Denmark in 2017–2019 (all women, HEMA tested at 1% pet.)[10] and 3.7% in Spain in 2019–2020 (HEMA had not yet been included in the Spanish routine series, the Spanish equivalent of the EBS).[11]

In the United States, HEMA has been present in the screening tray of the North American Contact Dermatitis Group (NACDG) since 2007. In the most recent 2019–2020 NACDG study, the prevalence of positive patch tests was 3.2%, which was a statistically significant increase compared with the pooled proportions of positive reactions of HEMA over the previous 10 years (2009–2018).[12]

In our study, nail cosmetics were the most frequent cause of allergic contact dermatitis, with 67% in the 46 patients with non-occupational allergic reactions and 61% in the women with occupational contact dermatitis (nail stylists) (66% in the total group). The same observation has been made in other studies with routine testing of HEMA, where 64% to over 80% of relevant reactions were related to cosmetic nail products[7–10] and 56%–97% of the patients with occupational allergic contact dermatitis were nail stylists/nail technicians/beauticians.[7,8,10]

In the Danish study, it was found that the proportion of HEMA test-positive patients with a history of using UV nail polish increased from 50% in 2017 to 85% in 2018 and 100% in 2019.[10] As a consequence of this major role of nail cosmetics, the large majority of patients sensitized to HEMA are currently female, in our study 90% and in other studies even 94%[7] and 97%.[10]

Culprit products other than nail cosmetics were mainly glues (including eyelash extension glues) and products with an adhesive surface containing (meth)acrylates such as TENS-electrodes, ECG-electrodes and medical band aids, and dental products. These were generally also the culprit product types seen in other similar studies.[7–10]

Five of our patients, who were primarily sensitized to nail cosmetics, later had allergic reactions to other (meth)acrylate-containing products such as dental products (of who one developed occupational ACD when she started working as a dental assistant) and TENS-electrodes. Such secondary reactions have previously been observed to dental materials such as dental fillings and restoration, orthodontic or occlusal splint materials and desensitizing dental swabs,[13–19] knee prostheses (bone cement)[20] and incontinence pads.[21] In a recent study, secondary reactions to printing inks, paints,[16] glues and sanitary napkins were also mentioned.[13] Fifteen per cent of patients sensitized by nail cosmetics later reacted to dental materials and 25% to sanitary napkins. However, most of the reactions were based on the responses to a questionnaire, only few could be verified.[13]

In conclusion, the addition of HEMA to the EBS has resulted in Amsterdam in a large number and high percentage of relevant positive patch test reactions, mainly in women and in nearly two thirds of the cases related to cosmetic nail products.

5 | LIMITATIONS

The limitations of this study include its retrospective design and selection of patients investigated in a tertiary referral centre. In most cases, the presence of HEMA itself in culprit (meth)acrylate-containing products could not be ascertained.

AUTHOR CONTRIBUTIONS

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

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

ORCID

Anton de Groot https://orcid.org/0000-0002-6666-7292
Thomas Rustemeyer https://orcid.org/0000-0001-7580-0684

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How to cite this article: Kocabas G, Steunebrink IM, de Groot A, Rustemeyer T. Results of patch testing 2-hydroxyethyl methacrylate (HEMA) in the European baseline series: A 4-year retrospective study. *Contact Dermatitis*. 2023;1-4. doi:10.1111/cod.14488