

CASE REPORT

Occupational asthma and rhinitis caused by cyanoacrylate-based eyelash extension glues

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Background	Eyelash extensions are applied on top of customers' lashes using instant glue containing cyanoacrylate, known to cause occupational rhinitis (OR) and occupational asthma (OA). The number of beauty professionals applying these extensions is increasing due to their popularity.
Aims	To report on a case of OA with OR and a case of OR attributable to lash extension glue and to evaluate respiratory exposure in lash extension work.
Methods	Two beauty professionals with suspected OA and/or OR underwent inhalation challenge, including both control challenge and work-mimicking challenges using the lash extension glue, each with a 24-h follow-up. Volatile organic compounds (VOCs) present were assessed during the lash extension glue challenge. The glues were analysed for their (meth)acrylate content.
Results	Both beauty professionals (case 1 and case 2) applied lash extensions regularly for several hours per day as part of their work and had work-related rhinitis. Case 1 had a longer history of lash extension work and also had asthmatic symptoms. The first lash extension glue challenge was negative in both cases, but positive OR reactions were detected in the second test. Case 1 also had a late asthmatic reaction. During the lash extension glue challenge, VOC were present in total concentrations below the irritant threshold and ethylcyanoacrylate (ECA) was detected in a concentration of 0.4 mg/m ³ . Chemical analysis of the glues revealed ECA was the major component.
Conclusions	Application of eyelash extensions using small amounts of cyanoacrylate-based glues can cause OA and OR.
Key words	Asthma; cyanoacrylate; eyelash extension; glue; occupational; rhinitis; specific inhalation challenge.

Introduction

Beauty professionals may handle chemicals that can cause respiratory symptoms [1]. Little is known about the sensitizing properties of these although the (meth)acrylates used in artificial nails [2,3] are recognized respiratory sensitizers.

In recent years, eyelash extensions have become increasingly popular worldwide. According to a 2012 survey by the Finnish Laurea University of Applied Sciences, about 2000 professionals regularly apply lash extensions in Finland (population 5.4 million), and the market of imported lash extension glues has approximately doubled during the last 2 years (personal communication). Lash extensions are attached to the customers' lashes with

cyanoacrylate-based instant glues, in the worker's breathing zone. Cyanoacrylate glues have caused occupational asthma (OA) in industrial settings [4] and also in one nail technician [3]. Recently, occupational allergic contact dermatitis caused by lash extension glue was reported in a lash beautician [5]. We report one case of OA and occupational rhinitis (OR) and one case of OR attributable to lash extension glue containing ethylcyanoacrylate (ECA).

Case reports

Both beauty professionals had applied extensions regularly to the eyelashes of several customers per day using lash extension glue at 30–50 cm from their faces. In case 1, symptoms appeared after 4 years, in case 2

after four months. Case 1 also had occupational allergic contact dermatitis caused by lash extension glue. Skin prick tests did not show IgE-mediated sensitization to lash extension glue.

Inhalation challenge took place in a 6-m³ challenge chamber on subsequent days, each with a 24-h follow-up. In the control challenge 2 ml of a control solution was sprayed into the chamber, in which the patient stayed for

15 min. Both patients underwent the lash extension glue challenge twice. In case 1, five drops of the glue were dripped into a beaker on a warm plate (35°C) three times (at 0, 15 and 30 min; total 15 drops), after which the patient stayed in the chamber for another 15 min. In case 2, the challenge was performed in the same way, but with three drops of glue dripped up to four times at 15-min intervals.

Table 1. Characteristics of patient cases, measurements during lash extension glue challenge and chemical analysis of the glues

	Case 1	Case 2
Demographics		
Age	37	22
Gender	Female	Female
Smoking	Ex-smoker	Current smoker
Pack-years	<1	<1
Atopy	No	No
Exposure		
Exposure to LEG, years	6	1
Duration of application task/day	3–9 h	4 h
Duration of exposure before symptoms	4 years	4 months
Respiratory protection	Paper mask occasionally	Paper mask occasionally
Use of protective gloves	No	No
Lash extensions applied to the patient herself	Twice	About 20 times
Exposure to methacrylates of artificial nails	Yes	No
Clinical details		
Respiratory symptoms related to LEG	Rhinitis, dyspnoea	Rhinitis
SPT to LEG ^a	Dermographismus	Negative (0 mm)
Medication for asthma and rhinitis	Inhaled fluticasone 500 µg/day	None
Bronchial hyperresponsiveness ^b	No	No
FEV ₁ , litres/% of predicted	2.97/83	3.38/90
FEV ₁ /FVC, absolute/% of predicted	70.82/85	94.40/106
FENO, ppb	34.2	11.9
Serial PEF monitoring at work and on days off	Suggestive worsening at work	Not measured
Specific inhalation challenge reaction ^c		
FEV ₁ decrease	–26% (late)	–6%
Change in bronchial hyperresponsiveness ^b	No	Not measured
Change in FENO, ppb	+25.8	Not measured
Nasal (amount of secretion)	Positive (920 mg)	Positive (2120 mg)
Diagnosis	Occupational asthma Occupational rhinitis Contact dermatitis ^d	Occupational rhinitis
Measurements and chemical analysis		
VOC during inhalation challenge (mg/m ³)	Not measured	TVOC: 0.48 ECA: 0.4
Chemical analysis of LEG	Glue 1 ECA: >95% ^e MMA: 0.072% BA: 0.014% Glue 2 ECA: >95% ^e MMA: 0.031% BA: 0.012%	ECA: >95% ^e MMA: 0.013%

LEG, lash extension glue; SPT, skin prick test; FEV₁, forced expiratory volume in 1 second; FVC, forced ventilation capacity; FENO, fractional exhaled nitric oxide; ppb, parts per billion; PEF, peak expiratory flow; TVOC, total concentration of volatile organic compounds; MMA, methylmethacrylate; BA, butylacrylate.

^aSPTs were performed with LEG as such.

^bIn bronchial challenge with histamine.

^cIn both cases, reactions were detected in the 2nd challenges to LEG. In Case 1, fluticasone was ongoing during the challenges.

^dAn earlier diagnosis of allergic contact dermatitis (caused by ethylcyanoacrylate and paraphenylenediamine).

^ePurity according to GC–MS analysis.

The specific inhalation challenge (SIC) was considered positive for OA if forced expiratory volume in 1 s fell by $\geq 20\%$ of the pre-challenge value in the glue challenge, without significant changes in the control challenge [6]. We evaluated the degree of rhinorrhea and nasal blockage using anterior rhinoscopy and scored them, both 20 min before and 20 min after the challenge [7]. A significant score change without significant changes following the control challenge was considered a positive OR reaction. We also measured the amount of nasal secretion running out of the patient's nose to the vestibulum of the nostrils. An amount more than 200 mg supported a positive test reaction.

In both cases, the first glue challenge was negative. The fact that case 1 used inhaled corticosteroids during SIC and had stopped lash extension work 9 months previously may have affected the outcome of this challenge. Moreover, earlier studies have shown that repeated challenges may be needed to confirm diagnosis [8]. Positive rhinitis reactions occurred in the second test, and case 1 had a prolonged late asthma reaction with an increase in fractional exhaled nitric oxide level, confirming the diagnosis of OA. This type of reaction caused by cyanoacrylate-based glues has been described before [4].

We assessed the volatile organic compound (VOC) concentration during case 1's SIC through Tenax sorbent tube collection and gas chromatography–mass spectrometry (GC–MS) analysis [9]. VOC concentrations were below the irritant level during the lash extension glue challenge, ECA concentration was about 40% of its Finnish occupational exposure limit, 1 mg/m³, and no other (meth)acrylates were detected. We analysed the beauty professionals' glues for their (meth)acrylate contents using GC–MS after extraction using

tert-butylmethylether. ECA was found to be the major component of the glues.

Table 1 describes the two cases, the results of air measurements and of chemical analysis of the glues. Figure 1 shows the SIC reaction in case 1. Both patients gave their written consent to testing and publishing.

Discussion

To our knowledge, this is the first report of OA and OR attributable to lash extension glue verified using a SIC, including a control challenge.

Cyanoacrylates such as ECA bond with even the most dissimilar materials quickly and firmly and consequently are used in instant glues for industrial and household purposes and in wound adhesives in health care. In addition to ECA, which has low volatility, small amounts of other alkyl-cyanoacrylates or (meth)acrylic derivatives may be present. Chemical analysis of the glues also revealed small amounts of methylmethacrylate and/or butylacrylate that, unlike ECA, evaporate quite easily. Nevertheless, the total amount of airborne (meth)acrylate derivatives is likely to be below the irritant threshold during the application of lash extensions. In the lash extension glue challenge in case 2, VOCs were found in the air, but their concentration was clearly below typical industrial levels and below the recommended limit for Finnish houses and offices (0.6 mg/m³). Individual components such as ECA were present in concentrations unlikely to cause airway irritation although ECA seems to have evaporated quite effectively considering its poor volatility and the small amount of glue applied. This supports the hypothesis that the reactions result from sensitization rather than from irritation.

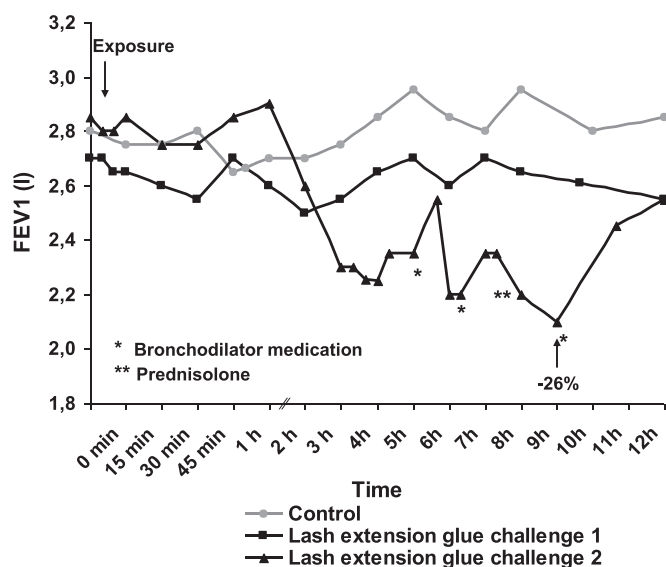


Figure 1. SIC of case 1, illustrating the changes in FEV1. The control challenge involved nebulizing 2 ml of the control diluent (solution of 0.5% NaCl, 0.4% phenol and 0.3% NaHCO₃ in sterile water) into the chamber by pressured air. The lash extension glue challenge lasted 45 min and was carried out twice with the patient's own glue. A late reaction was seen in the second challenge with the lash extension glue. *Bronchodilator medication; **Prednisolone.

In Finland, the rapid growth of the lash extension market in recent years makes the number of exposed workers difficult to estimate. Our cases applied lash extensions part time, but the number who work exclusively applying lash extensions seems to be increasing. In another activity with (meth)acrylate exposure, artificial nail application, Kreiss *et al.* reported an almost 3-fold-increased risk of asthma among beauticians [10]. This risk may also be increased in lash extension work although respiratory exposure is likely to be lower than in nail application.

Our results indicate glues containing cyanoacrylates may cause OA and OR in workers applying lash extensions. Cyanoacrylate glues are unlikely to be substituted by other glues in the near future because of their technical properties. The use of effective respiratory protective equipment in lash extension work would be beneficial, but it is likely to be poorly accepted. Additionally, effective local exhaust ventilation is not practical as the lashes may be caught by the airflow. Thus to prevent OR and OA salons offering lash extensions should provide effective general ventilation. Workers with symptoms should be evaluated fully and may need to change their work tasks.

Key points

- Eyelash extension glues for professional use are usually based on cyanoacrylates.
- Applying eyelash extensions may release cyanoacrylates into the air.
- Lash extension glues may cause occupational asthma and rhinitis.

Acknowledgements

Henna Ylilauri from the Laurea University of Applied Sciences is kindly acknowledged for the lash extension market survey.

Conflicts of interest

None declared.

References

1. Tsigonia A, Lagoudi A, Chandrinou S, Linos A, Evlogias N, Alexopoulos EC. Indoor air in beauty salons and occupational health exposure of cosmetologists to chemical substances. *Int J Environ Res Public Health* 2010;**7**:314–324.
2. Sauni R, Kauppi P, Alanko K, Henriks-Eckerman ML, Tuppurainen M, Hannu T. Occupational asthma caused by sculptured nails containing methacrylates. *Am J Ind Med* 2008;**51**:968–974.
3. Jurado-Palomo J, Caballero T, Fernández-Nieto M, Quirce S. Occupational asthma caused by artificial cyanoacrylate fingernails. *Ann Allergy Asthma Immunol* 2009;**102**:440–441.
4. Quirce S, Baeza ML, Tornero P, Blasco A, Barranco R, Sastre J. Occupational asthma caused by exposure to cyanoacrylate. *Allergy* 2001;**56**:446–449.
5. Pesonen M, Kuuliala O, Henriks-Eckerman ML, Aalto-Korte K. Occupational allergic contact dermatitis caused by eyelash extension glues. *Contact Derm* 2012;**67**:307–308.
6. Vandenplas O, Malo JL. Inhalation challenges with agents causing occupational asthma. *Eur Respir J* 1997;**10**:2612–2629.
7. Hytönen M, Sala E. Nasal provocation test in the diagnostics of occupational allergic rhinitis. *Rhinology* 1996;**34**:86–90.
8. Lemièrre C, Cartier A, Dolovich J *et al.* Outcome of specific bronchial responsiveness to occupational agents after removal from exposure. *Am J Respir Crit Care Med* 1996;**154**:329–333.
9. *Indoor Air—Part 6: Determination of Volatile Organic Compounds In Indoor and Test Chamber Air by Active Sampling on Tenax TA Sorbent, Thermal Desorption and Gas Chromatography Using MS/FID*. Geneva: International Organization for Standardization (ISO), 2004.
10. Kreiss K, Esfahani RS, Antao VC, Odencrantz J, Lezotte DC, Hoffman RE. Risk factors for asthma among cosmetology professionals in Colorado. *J Occup Environ Med* 2006;**48**:1062–1069.

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