Allergic contact dermatitis from a disposable blood pressure cuff containing isobornyl acrylate and 2-phenoxyethyl acrylate

Aerts Olivier (Orcid ID: 0000-0002-0076-2887)
MILPIED Brigitte (Orcid ID: 0000-0003-3679-6613)

Allergic contact dermatitis from a disposable blood pressure cuff containing isobornyl acrylate and 2-phenoxyethyl acrylate

Hélène Renaudin[1], Anne-Sophie Darrigade[1],

Ella Dendooven[2,3] ,Kenn Foubert[3], Olivier Aerts[2], Brigitte Milpied[1]

[1]Department of Dermatology, Hôpital Saint-André, CHU Bordeaux, France.

[2]Department of Dermatology, University Hospital Antwerp and Research group Immunology, Infla-Med Centre of Excellence, University of Antwerp, Antwerp, Belgium.

[3]Research group Natural Products & Food – Research and Analysis (NatuRA), Department of Pharmaceutical Sciences, University of Antwerp, Antwerp, Belgium.

Corresponding author

Dr. B. MILPIED, Service de Dermatologie, Hôpital Saint-André, 1 rue Jean Burguet, 33075 Bordeaux Cedex, France. brigitte.milpied@chu-bordeaux.fr

Funding: none to declare.

Conflicts of interest: none to declare.

Running title: Allergic contact dermatitis from IBOA in a blood pressure cuff.

Key words: allergic contact dermatitis, case report, children, diabetes mellitus, disposable blood pressure cuff, FreeStyle Libre, isobornyl acrylate, lauryl acrylate, medical devices, 2-phenoxyethyl acrylate.

Word count: 932

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/cod.13761

CASE REPORT

A 14-year-old boy, known with type 1 diabetes mellitus, had developed several episodes of allergic contact dermatitis (ACD) at the skin contact sites of a disposable blood pressure cuff (Philips, Amsterdam, The Netherlands)(**Figure 1A,B**), in 2018 and 2019, when he had been hospitalized due to diabetic ketoacidosis. The dermatitis had always occurred within a few hours following the application of the device. Previously, in 2017, he had been using the glucose sensor FreeStyle Libre (Abbott Diabetes Care, Witney, Oxfordshire, UK) which, after 3 months, had resulted in ACD, forcing the patient to rely again on skin finger pricks to monitor his glycaemia. His history revealed no other previous skin problems associated with the use of adhesives, wound dressings or any other medical device. When he was referred to our patch test clinic, in November 2019, he had no longer any active skin lesions, but clinical examination did show residual hyperpigmentation from the ACD caused by the glucose sensor (**Figure S2**). Patch tests were performed, according to ESCD guidelines (**1**), with the European baseline series, a plastics and glues series, and a (meth)acrylate series (including isobornyl acrylate [IBOA] 0.1%), all from Chemotechnique Diagnostics (Vellinge, Sweden). Moreover, (parts of) the medical devices were equally patch-tested “as is”: the skin adhesive of the FreeStyle Libre device, the external and internal parts of the blood pressure cuff (including the velcro adhesive), a piece of the tube attached to the cuff, as well as the disinfectant wipes that had been used to disinfect the skin before application of the devices.

Readings on day (D)2 and D4 showed positive reactions to many meth(acrylates)(**Figure S3**): IBOA 0.1% (+++), butyl acrylate [BA] 0.1% (++), tetrahydrofurfuryl methacrylate [THFMA] 2% (++), ethyl acrylate [EA] 0.1% (++), 2-hydroxyethyl acrylate [HEA] 0.1% (+), 2-hydroxypropyl methacrylate [HPMA] 2% (+),

ethyleneglycol dimethacrylate [EGDMA] 2% (+), 1,6-hexanediol diacrylate [HDDA] 0.1% (+), trimethylolpropane triacrylate [TMPTA] 0.1% (+), and triethyleneglycol diacrylate [TREGDA]0.1% (+). Patch tests were also positive to the skin adhesive of the FreeStyle Libre sensor (+++), the external and internal parts of the blood pressure cuff (++), as well as to the tube of the cuff (++). No reactions were observed to sesquiterpene lactones, nor to fragrances (**2,3**). The blood pressure cuff was sent to the Antwerp laboratory for chemical analysis, based on a previous protocol (**4**). These analyses showed the presence of IBOA (~ 10-20 ppm) in the part of the device where the tube is glued to the cuff, the cuff itself, and the adhesive part. Interestingly, also 2-phenoxyethyl acrylate (PEA) was present, and the analyses also showed the presence of lauryl acrylate (*syn.* dodecyl acrylate), based on the gas chromatography-mass spectrometry (GC/MS) database. (**3**). An additional patch test with PEA 0.1%, in-house prepared, using raw material from the industry (**3**), was sent to Bordeaux and equally resulted in a strong positive patch test (+++); lauryl acrylate was not available for patch testing.

DISCUSSION

No previous reports of ACD from disposable blood pressure cuffs have been published in the literature, nor personally observed in our hospital and, apparently, no such cases have been declared to the manufacturer either. Although the boy appeared to be polysensitized to multiple (meth)acrylates, he had no relevant history of previous skin reactions caused by medical devices or adhesives so far, except for ACD to the FreeStyle Libre sensor, caused by the contact allergen IBOA (**5**). As shown here, this subsequently put the child at risk of developing ACD from other IBOA-containing sources. The presence of IBOA in some medical devices might

actually be underestimated, as recent investigations have shown that some devices, even those once deemed to be free from IBOA (**6**), might still contain this sensitizer, depending, among others, on the specific chemical analytical tools used (**7**).

The FreeStyle sensor also contains potential other contact allergens, but, as recently demonstrated, no PEA (**3**). For the observed co-reactivity to the PEA-containing patch test preparation, and to the other acrylates, possible explanations include: (i) concomitant sensitization from other sources: given that the boy was already hospitalized several times, he was potentially at increased risk for cutaneous sensitization to (meth)acrylates from various medical devices, and adhesives, including the blood pressure cuff that had been repeatedly applied during previous hospitalizations; (ii) cross-reactivity between IBOA and PEA, and other acrylates, although IBOA rarely has shown any clear cross-reactivity to other acrylates so far (**3, 8**); (iii) the positive patch test reaction to PEA may actually have been provoked by IBOA, as recent analyses showed that raw materials of PEA obtained from the industry, as in the present case, may contain acrylate contaminants, among which IBOA. Unfortunately, the particular PEA patch test preparation could no longer be analyzed, and we were not able to re-test another preparation containing PEA in our patient. Nevertheless, the chemical analyses did confirm the presence of PEA in the blood pressure cuff. PEA is an acrylate only rarely reported as a potential contact sensitizer in medical devices, i.e. in insulin infusion sets (**9, 10**). Interestingly, in some of these cases, patients had also co-reacted to both IBOA and PEA, but no information on the purity of the patch test preparations was stated at that time (**9**). With regard to the presence of lauryl acrylate, it is tempting to speculate that this acrylate might disintegrate into BA and EA, two acrylates to which our patient was shown to be sensitized.

In conclusion, we report a first case of ACD caused by IBOA in a disposable blood pressure cuff, also shown to contain PEA, as a direct result of a previous primary sensitization to IBOA in the FreeStyle Libre glucose sensor.

REFERENCES

1. Johansen JD, Aalto-Korte K, Agner T, et al. European Society of Contact Dermatitis guideline for diagnostic patch testing - recommendations on best practice. Contact Dermatitis. 2015 Oct;73(4):195-221.

2. Herman A, Mowitz M, Aerts O, Pyl J, de Montjoye L, Goossens A, Bruze M, Baeck M. Unexpected positive patch test reactions to sesquiterpene lactones in patients sensitized to the glucose sensor FreeStyle Libre. Contact Dermatitis. 2019 Nov;81(5):354-367.

3. Dendooven E, Foubert K, Goossens A, Gilles P, De Borggraeve W, Pieters L, Lambert J, Aerts O. Concomitant positive patch test reactions in FreeStyle-allergic patients sensitized to isobornyl acrylate. Contact Dermatitis. 2020 Sep 23. doi: 10.1111/cod.13706.

4. Herman A, Aerts O, Baeck M, et al. Allergic contact dermatitis caused by isobornyl acrylate in Freestyle® Libre, a newly introduced glucose sensor. Contact Dermatitis. 2017; 77(6): 367- 373.

5. Pyl J, Dendooven E, Van Eekelen I, den Brinker M, Dotremont H, France A, Foubert K, Pieters L, Lambert J, De Block C, Aerts O. Prevalence and Prevention of Contact Dermatitis Caused by FreeStyle Libre: A Monocentric Experience. Diabetes Care. 2020 Apr;43(4):918-920.

6. Oppel E, Kamann S, Reichl FX, Högg C. The Dexcom glucose monitoring system-An isobornyl acrylate-free alternative for diabetic patients. Contact Dermatitis. 2019 Jul;81(1):32-36.

7. Svedman C, Bruze M, Antelmi A, Hamnerius N, Hauksson I, Ulriksdotter J, Mowitz M. Continuous glucose monitoring systems give contact dermatitis in children and adults despite efforts of providing less "allergy- prone" devices Investigation and advice hampered by insufficient material for optimized patch test investigations. J Eur Acad Dermatol Venereol. 2020 Oct 8. doi: 10.1111/jdv.16981.

8. Aerts O, Herman A, Mowitz M, Bruze M, Goossens A. Isobornyl Acrylate. Dermatitis. 2020 Jan 6. doi: 10.1097/DER.0000000000000549.

9. Busschots AM, Meuleman V, Poesen N, Dooms-Goossens A. Contact allergy to components of glue in insulin pump infusion sets. Contact Dermatitis. 1995; 33(3): 205- 206.

10. Jolanki R, Kanerva L, Estlander T, Henriks-Eckerman ML, Suhonen R. Allergic contact dermatitis from phenoxyethoxy ethylacrylates in optical fiber coating, and glue in an insulin pump set. Contact Dermatitis. 2001; 45(1): 36- 37.

Authors contributions :

H. Renaudin drafted the initial manuscript.

B. Milpied realized data collection, data interpretation, conceptualized and coordinated the work, drafted and critically reviewed the manuscript.

AS. Darrigade critically reviewed the manuscript.

OA. drafted and critically reviewed the manuscript.

ED. and KF. performed the chemical analyses and critically reviewed the manuscript.

Figure legends

Figure 1A,B : Allergic contact dermatitis (ACD) on the arm from a disposable blood pressure cuff containing isobornyl acrylate (IBOA) and 2-phenoxyethyl acrylate (PEA); note the residual hypopigmentation (*) from previous ACD due to the FreeStyle Libre glucose sensor.