

Usage of Hydrocolloid-Based Plasters in Patients Who Have Developed Allergic Contact Dermatitis to Isobornyl Acrylate While Using Continuous Glucose Monitoring Systems

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Abstract

Background: Continuous glucose monitoring (CGM) systems replace more and more capillary self-monitoring of blood glucose by patients with diabetes. However, at least a subset of patients experience adverse skin reactions such as severe allergic contact dermatitis (ACD) after prolonged usage of CGM systems. A major allergen isobornyl acrylate (IBOA) has been identified recently.

Objectives: After developing an ACD, patients have difficulties in continuing the usage of their CGM system (and also of, eg, certain patch pumps). Most of such patients look for possibilities to continue the usage of, eg, a CGM system that requires intermittent scanning (iscCGM, Freestyle Libre).

Patients and Methods: Eight patients with a known ACD were supplied with different hydrocolloid-based plasters ($n = 5$ with Hansaplast blister plaster, $n = 2$ with Cutimed Hydro B from BSN, and $n = 1$ with Stomahesive baseplate from Convatec). They attached these plasters to their skin underneath their iscCGM system.

Results: All patients were able to continue the usage of this iscCGM system when using such plasters.

Conclusion: Patients with ACD benefit from the usage of such plasters; however, some limitations have to be acknowledged.

Keywords

acrylates, allergic contact dermatitis, Freestyle Libre, hydrocolloid blister plaster, isobornyl acrylate, insulin pump, patch test

Introduction

New diagnostic options such as continuous glucose monitoring systems (CGMs) support patients with diabetes in managing their disease in daily life by providing detailed information about glucose changes over time. The wearing time of real-time (rt)CGM systems is seven or ten days, while that of a CGM system that requires intermittent scanning (isc) for data acquisition (Freestyle Libre, Abbott, Chicago) is 14 days. At least a subset of patients experience skin reactions after the wearing of the iscCGM system; unfortunately, no good epidemiologic data are available about how large this number is. Such skin irritations from occlusion, sweating under the sensor and tearing off the adhesive, seem to be very often controllable.¹ However, at

least some patients develop a severe contact dermatitis with strong redness, scaling, and sometimes exudation. Mostly, in these patients, itching is so intensive that they have to tear up the glucose sensor of this iscCGM system after a few days (Figure 1).

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Figure 1. Allergic contact dermatitis of a patient with type I diabetes developed after using an intermittent scanning continuous glucose monitoring system.

In 2017, the culprit allergen has been identified that triggers this allergic contact dermatitis (ACD) and patients developed a sensitivity to isobornyl acrylate (IBOA).² Further publications confirmed this report.^{3,4} A key aspect of these publications is that IBOA is not only part of the adhesive with which the iscCGM system works but is also part of the plastic housing of the bottom part of the glucose sensor.²⁻⁴ It appears as if IBOA somehow is resolved from the housing of these medical products and diffuses through the adhesive toward the skin.

A recent publication identified another acrylate, *N,N*-dimethylacrylamide (DMAA), which may also play a role as triggering allergen inducing an ACD while using the iscCGM system.⁵ Isobornyl acrylate has also been detected in a patch pump (Omnipod, Insulet, Acton, MA, United States), which is attached to the skin by an adhesive.^{6,7}

As most patients want to continue the usage of the iscCGM system (and other medical products for diabetes therapy), they try out many different options to be able to do so. They exchange numerous ideas and suggestions in several diabetes internet platforms; however, it appears as if there is only a small number of respective scientific publications.⁸ To avoid diffusion of IBOA to the skin, patients use different adhesives and special skin plates under their sensors. Nevertheless, it appears as if most constructions did not work over a longer period. The aim of this technical report is to present selected plasters that according to our experience enables patients with ACD to continue the usage of the iscCGM system over longer periods of time.

Table 1. Individual Demographic Data (Age) of Eight Patients With Type I Diabetes Tested Are Given, Along With Their Patch Test Series (Standard, Glue) and Specific Allergens Tested (Isobornyl Acrylate 0.1%).

Patient	Age	Sta	Glue	IBOA 0.1%	Plaster type
1	11	neg.	neg.	d3: ++	Hansaplast
2	56	neg.	neg.	d3: ++	Hansaplast
3	41	Ni d3: ++ neg.	d3: ++	Hansaplast	
4	28	neg.	neg.	d3: +	Hansaplast
5	56	neg.	neg.	d3: ++	Hansaplast
6	32	neg.	neg.	d3: +++	Cutimed
7	33	neg.	neg.	d3: +	Cutimed
8	48	neg.	neg.	d3: ++	Stomahesive

Abbreviations: d3, day three (or 72 hours) of patch test result; IBOA, isobornyl acrylate; neg.: negative; Ni: nickel; sta: standard series. All patients showed an allergic contact dermatitis to the intermittent scanning continuous glucose monitoring system. Also, the plaster which was placed under the glucose sensor of the intermittent scanning continuous glucose monitoring system of the individual patient is given.

Patients and Methods

The demographic data of eight patients with type 1 diabetes tested are given in Table 1. All these patients were known to have developed an ACD while using the iscCGM system. Also, the time of onset of the ACD to iscCGM system is given, along with the type of skin patch test series (see below) and allergens tested. All patients wear the iscCGM system on the upper arm. Figure 2 shows the skin underneath the glucose sensor of the iscCGM system after the usage for 14 days on patients 1, 6, and 8. All patients patch tested with IBOA showed a positive reaction. Such reactions could sometimes also be observed as allergens from additional patch test series, ie, one patient had a positive reaction to nickel.

In order to block an ACD reaction when the glucose sensor of the iscCGM system was applied, patients 1, 2, 3, 4, and 5 were provided with Hansaplast blister plasters from Beiersdorf AG (Hamburg, Germany), patients 6 and 7 with Cutimed Hydro B from BSN medical (Hamburg, Germany), and patient 8 with Stomahesive baseplate from Convatec (Deeside, United Kingdom). These plasters are acrylate-free and are not permeable to allergens like IBOA or DMAA. They are placed directly on the skin, whereas the sensor sticks on these plasters. Thus, they function as protection barrier intending to prevent potential allergens from diffusing out of the sensors' own adhesive or its plastic case toward the skin.

Patch Test

Patch skin tests were performed using allergens from the standard series and from the plastics and glues series used by dermatologists, following recommendations of the German Contact Allergy Group (Deutsche Kontaktallergie Gruppe; <http://dkg.ivdk.org/>). Also, a small sample of IBOA 0.1% in



Figure 2. (a) Hansaplast under the glucose sensor of the intermittent scanning continuous glucose monitoring system and (b) skin area after 14 days. (c) Cutimed Hydro B under the glucose sensor of the intermittent scanning continuous glucose monitoring system and (d) skin area after 14 days. (e) Stomahesive under the glucose sensor of the intermittent scanning continuous glucose monitoring system and (f) skin area after 14 days.

Table 2. Three Different Types of Plasters Have Been Studied and Worked Well in Preventing Allergic Contact Dermatitis Symptoms.

Plaster type	Size (cm)	Costs p. plaster	Cost p. wearing time	Characteristics
Hansaplast	5.8 × 3.4 (oval)	1€	2€ as 2 are needed	Good wearing comfort
Cutimed	10 × 10	8€	8€	Expensive, good fixation
Stomahesive	10 × 10	5.60€	1.30€, plaster is dividable in 4	

Their name, size, approximate cost per plaster, costs per wearing time in Euro, and special characteristics are given.

petrolatum (pet.) was tested. This was prepared in the laboratory of the Department of Dermatology and Allergology, Ludwig-Maximilian-University, Munich. Following skin occlusion for two days, all patch test reactions were read, according to guidelines, on day two and day three, and sometimes also later because of acrylate-associated delayed reactions.

Results

When using the three different plasters, seven of the eight patients were able to wear the iscCGM system for the whole

time of 14 days (Table 1). Patient no. 3 (with Hansaplast) had to remove the glucose sensor earlier, because after 11 days the plaster did not stick strong enough anymore to the skin. Patient no. 8 (with Stomahesive) experienced some itching and redness at the edges of the plate, yet, the symptoms were only from time to time.

In the months after the initial observation period, all patients were able to use the iscCGM system with the additional plasters for several months with success. However, patient no. 8 switched from one product to the other (from Stomahesive to Hansaplast) because of the better wearing comfort.

Discussion

Development of an ACD in patients using the iscCGM systems typically takes at least months and in some patients even longer. Many of the patients with an ACD would prefer to continue the usage of this iscCGM system for a number of reasons also for cost reasons. According to our experience, the usage of the three different types of plaster studied can be a help for such patients. In Table 2, we have listed these three types with name, size, approximate cost (order costs?) per plaster and cost (order costs?) per wearing time, and special characteristics. It remains to be studied, if such plasters also work in patients who show skin reactions while using other CGM systems or patch pumps (like the Omnipod). There is a recent report about the successful usage of Cavilon film in a patient with an ACD induced by IBOA.⁸ However, to our knowledge, such skin protection barrier films are not able to protect the skin longer than a few days.

In the small number of patients studied by us, the Hansaplast blister plaster worked well with a gentle wearing comfort. Yet, generally one plaster is too small, so patients with an ACD need to use two of them at the same time with a given overlap. Patients with an ACD to the patch pump will need three of the plasters at the same time because of the larger footprint of the housing. Other blister plasters than Hansaplast blister plaster did not work so well in our patients. Also, the Cutimed Hydro B plaster has been used over months with good success by two patients. This plaster consists of a silicone/hydrocolloid mixture, sticks well over a whole wearing period of 14 days, and is very gently removable. The Stomahesive baseplate can be divided into four pieces, so the costs of these additional parts are lower. This plaster is usually used in stoma patients and is based on hydrocolloids. It is thicker than the other plasters and it does not stick so firmly to the skin over 14 days. After some days, the edges crumple, and sometimes patients notice redness and some itching at these sites.

It has to be mentioned that the usage of such protective adhesives introduces some limitations, such as a reduced wearing comfort. Patients studied were instructed to design some kind of a former plate which they can use every time to scribe the edges of their, eg, sensor on the plaster. Before placing the sensor, a little hole is punched so that the sensor filament can reach the skin. However, sometimes this construction does not work so well because the sensor filament cannot be correctly placed. Also, at the site of sensor filament placement, some redness and itching may occur. At least in some patients, the insertion depth of the sensor tip in the skin might be not sufficient, ie, the glucose concentration is not measured in the interstitial fluid of the subcutaneous tissue but intradermal. There is also a risk that the sensor slips out of the skin.

In summary, additional or certain plasters enable patients with an ACD to certain acrylates to continue the usage of an iscCGM system. Such plasters might also be of help in other patients who show an ACD while using other medical products for their diabetes therapy. Nevertheless, such solutions should be seen as temporary solutions; potent allergens such as IBOA should be eliminated from such medical products.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: SK has no conflict of interest. LH is a consultant for a number of companies that develop novel diagnostic and therapeutic options; a shareholder of Profil Institut für Stoffwechselforschung, Neuss, Germany and ProSciento, San Diego, United States; and a member of an Abbott advisory board in Germany. EO has no conflict of interest.

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