

Allergic contact dermatitis caused by 2-ethyl cyanoacrylate contained in glucose sensor sets in two diabetic adults

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Continuous glucose monitoring with transcutaneous sensors is becoming a sophisticated method for controlling and regulating glucose metabolism in diabetics.

Allergic contact dermatitis caused by the glucose sensor set Dexcom G4[®] Platinum has hitherto been reported only once, in a diabetic child (1).

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Case Reports

We here report 2 adult insulin-dependent diabetic patients who became sensitized to the glucose sensor set Dexcom G4[®] Platinum Sensor (Dexcom, San Diego, CA, USA).

Case 1: A 36-year-old male office worker, who was suffering from type I diabetes mellitus, had been using a Dexcom G4[®] Platinum Sensor for glycaemic control for 6 months, and developed pruritic and eczematous dermatitis at the contact sites on the abdomen after 1 month of use (Fig. 1a). He had no history of personal atopy, but his brother suffered from hay fever. The patient was patch tested with the European baseline series, an acrylate series, a plastic and glue series (Chemotechnique, Vellinge, Sweden; and Trolab, Almirall Hermal, Reinbek, Germany), and parts of the Dexcom G4[®] Platinum Sensor. The patch test materials used were IQ Ultra[®] Chambers (Chemotechnique) covered on the upper back with Mefix[®] (Mölnlycke Healthcare, Gothenburg, Sweden). The patch tests, read according to ESCD criteria (2) on day (D) 2 and D4, showed positive reactions to 2-ethyl cyanoacrylate (D2, +; D4, +) and parts of the Dexcom G4[®] Platinum Sensor (D2, +; D4, +) (Fig. 1b).

Case 2: A 28-year-old woman with type I diabetes mellitus was referred with a pruritic erythematous and squamous eruption at the glucose sensor sites on both arms (Fig. 2a). She had been applying the Dexcom G4[®] Platinum Sensor for 16 months, and the skin problem had started 4 months later. To try to prevent reactions, she was using a skin protection film (Tensor Spray[®]; Quin Global, Perth, UK) on the arms and the abdomen, where the insulin pump was fixed; there was no reaction at the insulin pump site. Two months later, she had also started to develop an eczematous eruption around all of her fingernails, following the use of nail gel and the application of artificial nails (Fig. 2b). She had no history of personal atopy, but her mother was suffering from asthma. She was working in child care and practised nail art as a hobby. She had no known allergy to adhesive dressings. Patch tests were performed with the the European baseline series, an acrylate series, a plastic and glue series, the Tensor Spray[®], and with the nail cosmetics (semi-open tested 'as is'), with the same materials and methods as in case 1. Patch test readings on D2, D4 and D7 showed positive reactions to nickel (D2, +; D4, +; D7, +), 2-ethyl cyanoacrylate (D2, +; D4, +; D7, +), hydroxyethyl acrylate (D2, –; D4, –; D7, +), ethyleneglycol dimethacrylate (D2, –; D4, –; D7, +), and hydroxyethyl methacrylate (D2, +; D4, +; D7, +) (Fig. 2c). In the semi-open tests, she also reacted positively to the nail glue containing 2-ethyl cyanoacrylate, and to an all-in-one colour gel and builder gel, both containing hydroxyethyl methacrylate. The reaction to Tensor Spray[®] tested in a repeated open application test was considered to be irritant, as no reaction to it had occurred on the abdomen.

In both cases, allergic contact dermatitis caused by the adhesive part of the glucose sensor set Dexcom G4[®] Platinum was diagnosed.

Acetone extracts of the adhesive patch and the sensor (without the adhesive patch) were analysed with gas chromatography (GC)–mass spectrometry (MS) at the department of Occupational and Environmental Dermatology in Malmö. The GC system consisted of an Agilent 6890N gas chromatograph (Agilent Technologies, Santa Clara, CA, USA) equipped with an HP-MSI capillary column (Agilent Technologies) with a length of 30 m, an internal diameter of 0.25 mm, and a film thickness of 0.25 μ m. The carrier gas was helium of Alphagaz 2 quality (Air Liquide, Malmö, Sweden), with a flow rate of 1.0 ml/min. The injection was splitless, and the inlet was heated to 250°C. The injection volume was 1 μ l. The temperature programme was as follows: isothermal at 70°C for 3 min, an increase in temperature of 8°C/min to a final temperature of 300°C, and isothermal at this temperature for 10 min. Electron-ionization mass spectra were recorded with a Jeol GCmate II mass spectrometer (Jeol Datum, Tokyo, Japan) in scan mode, recording ions with m/z from 50 to 600 u, with a scan duration of 0.3 seconds and an interscan delay of 0.2 seconds. The temperature of the ion source was 250°C, and the GC–MS interface temperature was 250°C. The electron energy was 70 eV. 2-Ethyl cyanoacrylate (Sigma-Aldrich, Steinheim, Germany) dilutions in acetone were used as reference standards. 2-Ethyl cyanoacrylate was found in extracts of both the adhesive part and the sensor part of the device, with approximate contents of 0.9 mg/cm² in the adhesive patch and 1.0 mg/cm² in the sensor.

Discussion

In diabetic patients, the self-monitoring of blood glucose is increasingly being replaced by real-time continuous glucose monitoring to optimize glycaemic control. Current models of continuous glucose monitoring measure the glucose concentration in the interstitial fluid every 1–5 min for up to 7 days via a short subcutaneous probe (glucose sensor) (3). According to the manufacturer of the Dexcom G4[®] Platinum Sensor (1), the sensor pod is attached to the adhesive non-skin part with cyanoacrylate glue from Loctite[®] (Henkel, Düsseldorf, Germany), which is also widely used as a household and an industrial contact adhesive. Moreover, it is found in nail cosmetics, such as in glues to fix artificial nails, in dental restoration products, and in bone cement.

In 2007, Jadviscokova et al. (4) had already mentioned minor local adverse events resulting from the use

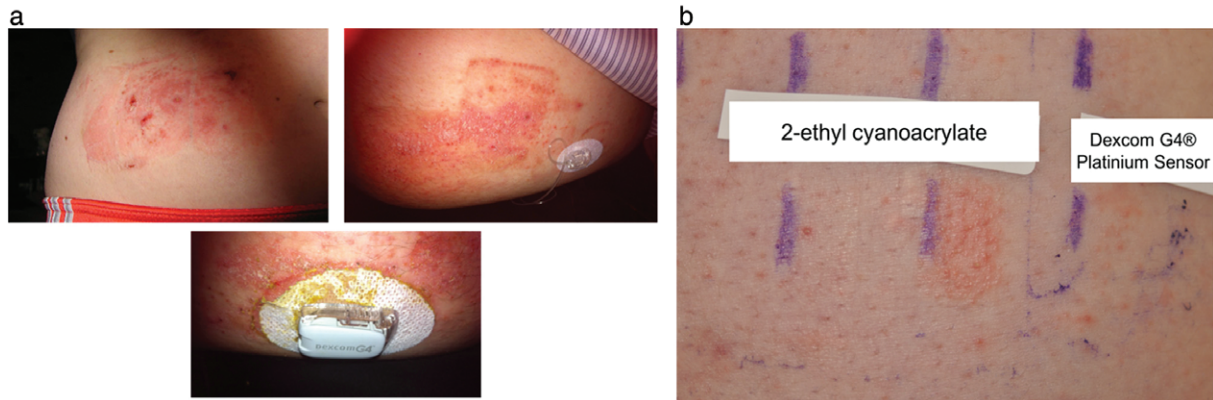


Fig. 1. (a) Pruritic eczematous dermatitis at the glucose sensor sites on the abdomen. (b) Positive patch test reactions to 2-ethyl cyanoacrylate (D4, +) and the Dexcom G4® Platinum Sensor (D4, +).

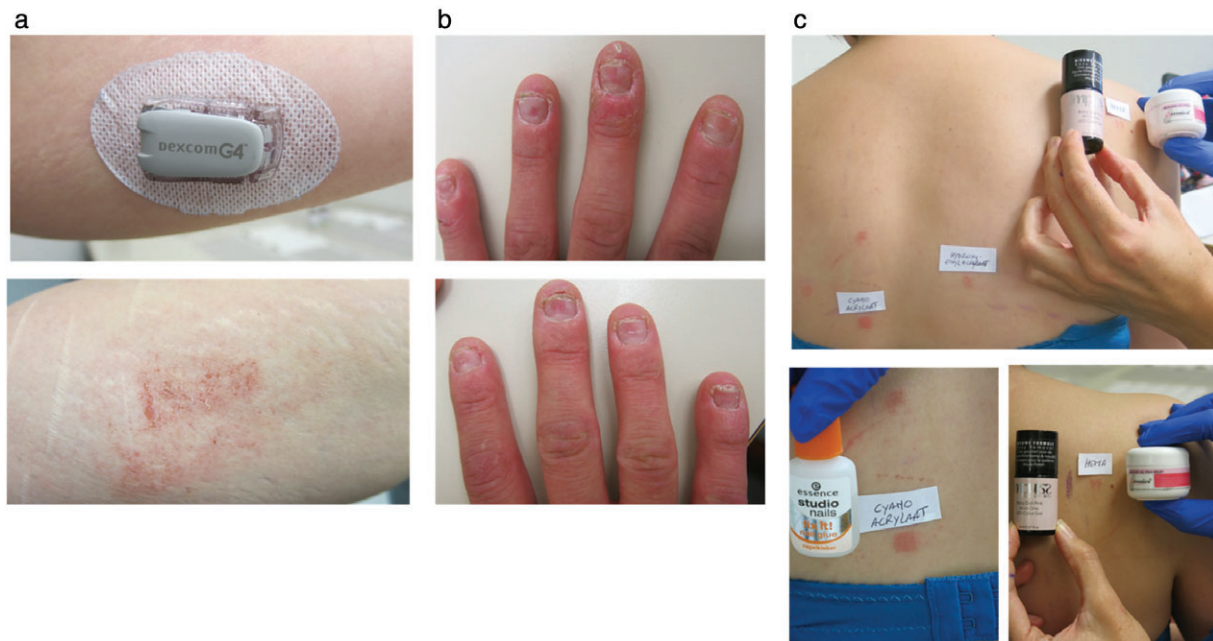


Fig. 2. (a) Pruritic erythematous and squamous eruption at the glucose sensor set site on the arm. (b) Eczematous eruption around all fingernails following the use of nail gel and the application of artificial nails and nail gels. (c) Positive patch test reactions to 2-ethyl cyanoacrylate (D7, +), hydroxyethyl acrylate (D7, +), and hydroxyethyl methacrylate (D7, +), as well as positive semi-open test results with the nail cosmetics.

of glucose sensor sets in terms of hypersensitivity, itching, pain, redness, burning, subcutaneous haemorrhage, and problems related to the adhesive tape and/or sensor. Indeed, prolonged exposure carries the risk of allergic skin reactions to adhesive material (5).

Hitherto, adverse skin reactions to glucose sensor sets have, surprisingly, been reported rarely. Difficulties in obtaining information on materials used in the adhesives from manufacturers marketing such devices may explain this. Most current adhesives are composed of

acrylate polymers, which are a mixture of mostly three different acrylate monomers. These are strong skin sensitizers, in contrast to completely polymerized acrylates, which are generally considered to be non-irritant and hypoallergenic (5).

Both patients reacted positively to 2-ethyl cyanoacrylate, which was therefore suspected to be the causative agent of allergic contact dermatitis caused by the sensor. Patients were possibly primarily sensitized during prolonged exposure; however, in the second

case, exposure to acrylics contained in gel nails, polishes and glues, that is, 2-ethyl cyanoacrylate in the nail glue, and methacrylates in the other nail cosmetics, subsequently led to dermatitis around the nails and severe nail damage (Fig. 2b). Cyanoacrylates only infrequently cross-react with acrylates and methacrylates, but may occasionally cross-react among each other (6, 7).

In conclusion, we report 2 additional cases of allergic contact dermatitis caused by a glucose sensor set, namely, the Dexcom G4® Platinum Sensor. The culprit

allergen is most probably the 2-ethyl cyanoacrylate contained in the adhesive part of the sensors. These cases indicate that glucose sensor set potential sensitizers in diabetic patients, and that such devices should be avoided by patients reacting to nail cosmetics based on acrylics. There is a need for more safety data on adhesive materials used for continuous glucose monitoring, and a need for full declaration of the composition of medical device adhesives.

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