

Contact allergy to 2-amino-2-methyl-1-propanol in a metalworking fluid

Johannes Geier^{1,2}  | Susann Forkel^{2,3} | Anne Heetfeld^{2,3} | Holger Lessmann^{1,2} | Timo Buhl^{2,3} 

¹Information Network of Departments of Dermatology (IVDK), Institute at the University Medical Centre Göttingen, Göttingen, Germany

²Comprehensive Allergy Centre South Lower Saxony, Göttingen, Germany

³Comprehensive Allergy Center South Lower Saxony, University Medical Center Göttingen, Göttingen, Germany

Correspondence

Professor Dr Johannes Geier, Information Network of Departments of Dermatology (IVDK), Geiststr. 3, 37073 Göttingen, Germany.

Email: jgeier@gwdg.de

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2-Amino-2-methyl-1-propanol (AMP) (isobutanolamine; CAS no. 124-68-5; Figure 1) is used as an emulsifying agent and pH adjuster in cosmetics, as a dispersing agent in paints, and as a corrosion inhibitor with antimicrobial properties in metalworking fluids (MWFs).^{1,2} AMP may cause skin irritation, but it is neither classified as a sensitizer nor labelled with H317 ("May cause an allergic skin reaction").² We report a case of probable allergic contact dermatitis caused by AMP in a MWF.

CASE REPORT

A 55-year-old Caucasian non-atopic metalworker presented with a 5-month history of work-related hand eczema. He had worked as a cutter, turner and grinder of metal materials for almost 40 years, with only a few interruptions. In his current position, which he held since 2003, he operated a CNC turning machine. He rarely wore protective gloves, and therefore had skin contact with water-based MWFs (wbMWFs). In 2014, a new wbMWF was introduced that contained, among other components, AMP (maximum level of 3% in the concentrate) and iodo-propynyl butylcarbamate (IPBC). Our patient had contact with this MWF almost every day. Checks by the company showed that, temporarily, the MWF concentration was too high (up to 14% instead of 10% maximum). Three years later, dermatitis of the fingers occurred; this improved under treatment with topical corticosteroids when the patient was off work, and relapsed when he was at work. In the course of time, the hand eczema worsened, and subungual hyperkeratosis with greenish discolouration of fingernails D II and D III of both hands occurred (Figure 2). A superinfection with staphylococci and *Aspergillus niger* was diagnosed and treated accordingly. Some weeks later, the

dermatitis had cleared, and the patient returned to work. Within a few days, the finger dermatitis relapsed, periorbital dermatitis developed, presumably attributable to MWF splashes and fog, and the work trial had to be stopped after 3 weeks. The same happened after another attempt a few months later.

The patient was patch tested at our department with the baseline series, metalworking fluid series, preservative series, and the ointment base series of the German Contact Dermatitis Research Group. Some complementary industrial biocides were also patch tested. Test preparations were purchased from SmartPractice Europe (Barsbüttel, Germany) and from Chemotechnique Diagnostics (Vellinge, Sweden). Patch tests were exposed for 2 days, and read on day (D) 2, D3, and D7, according to ESCD guidelines.³ A weak positive reaction to sodium metabisulfite 1% pet. on D7 (doubtful on D3) and doubtful reactions with few follicular papules to IPBC 0.2% pet. on D3 and D7 were noted. All other tests, including those with monoethanolamine, diethanolamine, triethanolamine, and diglycolamine, gave negative results. A patch test with the wbMWF from the workplace (used "as is"; exposure time of 1 day) elicited doubtful reactions on D1, D2, and D3, and a weak positive reaction on D7.

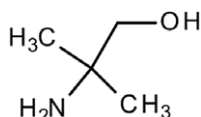


FIGURE 1 Chemical structure of 2-amino-2-methyl-1-propanol (AMP; isobutanolamine; CAS no. 124-68-5)



FIGURE 2 Fingertip dermatitis with staphylococcal and fungal superinfection

Some weeks later, in a second patch test, the concentrate of the incriminated wbMWF was tested 5% aq. (exposure time of 1 day), and elicited a doubtful reaction on D2, and weak positive reactions on D3 and D7. Patch test with other oils from the workplace (50% in olive oil) gave no reactions. AMP was purchased from Sigma-Aldrich (Steinheim, Germany), and a test substance with AMP 2% pet. was prepared at the Göttingen University Medical Centre pharmacy. Patch testing with AMP 2% pet. (exposure time of 2 days) elicited a weak positive reaction on D3, and few follicular papules on D7. Repeat patch tests with IPBC and sodium metabisulfite yielded the same results as before.

The wbMWF of the CNC turning machine at the patient's workplace was changed to a product without AMP, which, however, was preserved with IPBC. Since then, he has been able to continue working basically without dermatitis. As the formerly used wbMWF with AMP is still being used in the company, he occasionally has accidental skin contact with this when handling workpieces covered with this MWF, and consequently has observed relapses of hand eczema.

DISCUSSION

Up to now, contact sensitization to AMP has never been reported. AMP is used in a variety of cosmetic products, primarily in aerosol hair sprays and hair dyes. According to a survey conducted by the Cosmetic, Toiletry and Fragrance Association, the highest use concentration reported for AMP is 7% in hair dyes and colours.¹ Guinea-pig tests with AMP have shown no sensitizing potential. Some human repeated insult patch tests have been performed with formulations containing up to 7% AMP, resulting in only single transient doubtful reactions or no reactions at all.^{1,2} In view of these results, the Cosmetic Ingredient Review Expert Panel concluded, in their safety assessment published in 2009, that AMP is safe as a cosmetic ingredient under the conditions of use.¹

In a report from Italy published in 1997, work-related airborne contact dermatitis caused by AMP in two hair dye production workers was described.⁴ A dilution series with AMP (0.1%-20%) in water and ethanol was patch tested. Patch tests showed positive reactions to AMP 10% and 20% in both vehicles, but not to lower concentrations. However, the same reaction pattern was noted in two additionally tested exposed, but non-symptomatic, individuals, as well as in six non-exposed, non-symptomatic individuals. On the basis of these results, irritant (and not allergic) airborne contact dermatitis caused by AMP was diagnosed.⁴

At the beginning of the century, in a multicentre study,⁵ AMP 1% aq. was patch tested in 160 patients with dermatitis presumably caused by MWF, and yielded only negative reactions. The test vehicle in this study was water, because the test preparation was made from an aqueous stock solution containing 75% AMP, and hence no pet.-

based preparation could be made. Possibly, however, the test concentration, which was chosen cautiously to avoid irritation, was too low to detect sensitization.

To our knowledge, this is the first case report of probable allergic contact dermatitis caused by AMP. Although we could not perform any control patch tests with AMP 2% pet., we think that the positive test reaction indicated relevant contact sensitization, because, after avoidance of the skin contact with AMP, the patient's dermatitis resolved. In contrast, the doubtful test reaction to IPBC did not seem to indicate contact sensitization, because the continued exposure to IPBC at the workplace obviously had no negative effect on the patient's skin condition. Concerning the reaction to sodium metabisulfite, we could not find any clinical relevance. Neither any metabisulfites nor chemically related compounds were currently present at the patient's workplace or in his private environment (as far as was ascertainable). For future patch testing with AMP, we recommend a patch test concentration of 2% pet., which is similar to the proven test concentrations of monoethanolamine and diethanolamine.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

ORCID

Johannes Geier  <https://orcid.org/0000-0002-5047-8948>

Timo Buhl  <https://orcid.org/0000-0002-3139-129X>

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