Mercury Poisoning of a 4-Year-old Child by Indirect Contact to a Mercury Containing Facial Cream: Case Report

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Case report

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Abstract

A 4-yr old patient was admitted to the hospital with pain attacks in his extremities, tachycardia, hypertension, increased sweating, behavioral changes and weight loss. Extensive examinations eventually revealed an acute mercury poisoning. The mercury levels in blood and urine were 36.7 µg/l and 90 µg/g creatinine, respectively. A facial cream bought online, containing approximately 18 % mercury, was identified as the primary source of intoxication. The symptoms improved after disposal of the cream and chelation therapy. Biomonitoring of the mother and the brother, who remained asymptomatic, indicated an increased exposure to mercury, too. The mother, who had been using the cream for approximately three months, denied its application on her children. Further analyses, home visits and interviews suggested that the child was accidently intoxicated by skin-to-skin contact with the mother. Other mercury sources were excluded and mercury levels decreased considerably over time. The family will be closely monitored to exclude any long-term health issues. Lessons learnt from this case of an acute mercury intoxication is that even skin to skin contact with a mercury containing cream can have significant negative health effects for a child.

Background

Acute mercury poisoning is a rare condition in European countries nowadays. This is mainly caused by the reduced mercury use in industry and household applications. However, multiple cases of mercury poisoning due to the use of skin-whitening creams have been reported [1–7]. These creams are used to achieve a lighter skin-tone, a desired ideal of beauty in many countries. Although not all skin-lightening creams contain substantial amounts of mercury, recent studies showed that mercury is regularly added to such creams [7–10]. The mechanism behind the skin-lightening effect is the inhibition of the melanin production by mercury [11]. In vitro studies showed that inorganic mercury species, which are predominantly used in skin-whitening creams, could penetrate the skin [5].

The case reports associated with skin-lightening creams frequently describe enormous diagnostic difficulties connecting the symptoms to mercury poisoning. This can be explained by the rarity of such poisonings in developed countries as well as by the unspecific symptoms that are often attributed to other diseases. Our case, which involved a mercury-containing facial cream that was not advertised as a skin-lightening cream, reflects the considerable challenges of diagnosing a mercury intoxication and reveals novel exposure pathways.

Case Presentation

In Summer 2018, a 4-year old boy was admitted with loss of weight (two kilograms in four weeks), weakness, fatigue, strong sweating, arterial hypertonia (114/104 mmHg) and tachycardia (> 150 bpm). Furthermore, he complained about pain in stomach and joints. The boy’s behavior was shy and uncooperative. According to his parents, he had been a lively and happy child before. Blood tests were mainly unremarkable, except for elevated aldosterone levels. Ultrasound scans of the abdomen, hips and
ankles were normal. He was discharged and 3.75 mg Amlopidin per day were prescribed to control his blood pressure. However, the patient showed no signs of improvement. A chest x-ray and whole-body MRI showed no signs of tumors, but unspecifically enlarged lymph nodes in the axilla and under the carotid sheath. Microbiological studies and standard laboratory tests were negative. Due to the ongoing hypertonia and tachycardia, 3.75 mg Propanolol three times per day was added to his medication.

Six weeks after his first admission, the patient's blood was tested for lead and mercury, as one of the authors remembered a similar case years ago. The blood lead level (16 µg/l) was below the German reference value for children (20 µg/l) [12]. In contrast, mercury levels (Table 1) in urine (90 µg/g creatinine) and blood (37 µg/l) were extremely elevated compared to reference values and significantly above the Human-Bio-Monitoring level II (danger level) value proposed by the Human Biomonitoring Commission of the Federal Environmental Agency (UBA) [13]. The patient immediately received chelation therapy with 40 mg Dimaval® (2,3-Dimercapto-1-propanesulfonic acid) twice per day. His condition improved rapidly and he could be discharged. Chelation therapy was continued until mercury levels were below the Human-Bio-Monitoring level I (considered as a safe level) (Fig. 1). Six months after hospital discharge, the patient's urinary and blood mercury levels decreased significantly (Table 1) and his symptoms had disappeared. Follow-up visits are intended to identify potential re-exposure and exclude any long-term effects.

Table 1

| Family member | Urinary mercury [µg/l] | Creatinine-corrected urinary mercury [µg/g creatine] | Blood mercury [µg/l] |
|---------------|------------------------|-----------------------------------------------|---------------------|
|               | start | end | start | end | start | end |
| Patient       | 19    | 6.3 | 90    | 5.4 | 37    | 1.5 |
| Mother        | 198   | 60  | 341   | 45  | 49    | 1.8 |
| Brother       | 22    | 6.7 | 33    | 4.9 | 14    | 1.7 |
| Father        | n.a.  | 2.6 | n.a.  | 2.7 | n.a.  | 0.5 |
| Reference value | 1.0  | 1.0 |      |     | 0.8   |     |
| HBM-I (alert level) | 7    | 5   |      |     | 5     |     |
| HBM-II (danger level) | 25   | 20  |      |     | 15    |     |

n.a.: data not available, HBM = Human Biomonitoring

Identification of the source of intoxication and biomonitoring of the family members
Soon after diagnosis, efforts were made to identify the source of exposure. There were no mercury thermometers or broken energy saving light bulbs in the household. Asked about any unusual household remedies connected to the family’s origin (Balkan), the mother explained that she had started using a face cream from the Kosovo, which she had bought online. Laboratory analyses of the cream revealed a mercury content of ~18%. This is comparable to what has been previously reported for skin-lightening creams [7, 10]. However, the cream was not advertised as a skin-lightening cream, but for achieving a better skin appearance. According to the manufacturer, the cream has an “immediate effect and success in problems such as: Acne, pimples, facial scars after birth, sunspots, signs after acne, etc” [14]. Obviously, mercury was not listed as an “active” ingredient. The mother insisted that she had never used the cream on her children. Nevertheless, blood and urine samples from all family members were analyzed, too (Table 1). As expected, the mother’s mercury levels were extremely high due to the use of the cream over several months. The patient’s 9-year old brother also showed elevated mercury levels. Surprisingly, both mother and brother showed no clinical signs of mercury poisoning. The father’s mercury levels were relatively low.

To exclude any other exposure sources, the family’s apartment was thoroughly inspected. Ambient air monitoring with revealed no elevated mercury levels compared to local background levels (~0.1 µg/m³). Analyses of dust samples from the family’s vacuum cleaner showed values of up to 68 µg/g dust, which is significantly higher than the reference values for indoor dust samples [15]. Repeated analyses of indoor dust samples showed a decrease in mercury levels over time (Fig. 2). Dust samples from the parent’s bedroom, taken approximately four months after the identification of the source, showed higher levels than in the other rooms (8.4 µg/g vs. 3.3 µg/kg in the living room and 5.4 µg/g in the children’s bedroom).

Additionally, hair samples (~30 cm long) from the mother were taken about four months after she stopped using the cream. The hair was cut into 2 cm long segments and analyzed. The results are shown in Fig. 2. The lowest mercury levels were found closest to the scalp and increased with growing distance to the skin up to 89 µg/g hair. Until 14 cm length mercury levels increased exponentially, thereafter, the increase is linear. The levels found in her hair are higher to what has been previously reported for the use of skin-lightening creams [10].

**Discussion**

We report the case of a boy with a serious mercury poisoning due to his mother’s use of a mercury-containing facial cream. As described in similar case reports, the diagnosis was extremely challenging due to unspecific symptoms that could be associated with other diseases [1, 2]. In this case, the final diagnosis was made approximately six weeks after the first symptoms occurred. The patient was immediately treated with a chelating-agent. Consequently, urinary mercury excretion dramatically increased after the treatment started, but decreased rapidly after a couple of days along with the blood mercury levels (Fig. 1).

Mercury-containing creams are known to be responsible for intoxications. However, the published reports likely represent a fraction of the actual cases. Most likely, consumers and physicians do not instantly associate occurring adverse health effects with mercury poisoning and the use of such creams. In some
cases, the use of mercury-containing creams appears to even cause asymptomatic intoxications, as it has been observed for the mother and brother. At first, it was unclear, how the boy was poisoned. After the exclusion of other mercury sources, it was evident that the facial cream directly or indirectly caused the intoxication. The ingestion of the cream or mercury-contaminated dust caused by the cream was considered a possible route of exposure. However, the cream was kept away from the children and we excluded a severe mercury intoxication by dust ingestion, as the apartment was very clean and without visible dust. Therefore, the absorption of mercury via skin remained the only plausible cause. Although mercury in creams is readily absorbed into the skin \cite{5}, residual amounts may remain on the skin surface for some time. In our opinion, the mercury-containing cream was likely transferred by skin-to-skin contact. According to the mother, she had used the cream on herself before she went to bed. The patient commonly slept in the parent’s bed, implying frequent and enduring skin contact. Depending on the retention time of the cream on the skin, transmittal of mercury could have also occurred during daytime via cuddling. His older brother, who did not sleep in the parent’s bed and spent less time at home due to his school attendance, had probably less skin contact, explaining his lower mercury levels and asymptomatic intoxication.

That the cream remained on the mother’s skin for some time was confirmed by the analysis of mercury in her hair (Fig. 2). Based on our initial hypothesis that the mercury deposition in the hair was caused by the blood mercury, we expected the maximum levels to be around the time the mother stopped using the cream (day 0). In contrast, mercury accumulated over time. Furthermore, the levels in hair are significantly higher to what has been reported for people with comparable blood mercury levels in artisanal and small-scale gold mining areas \cite{16,17}. Therefore, her hair must have absorbed mercury due to contact with the cream, either during application (hairline) or sleep (all hair). Hair is rich in cysteine, which forms a complex with mercury, causing an accumulation over time \cite{10,18}. The high concentration of mercury in hair, together with skin shedding, also explain the levels in dust. We advised the family to regularly vacuum-clean the apartment and avoid any dust formation, as the mercury levels in dust remained relatively high.

**Conclusion**

In summary, this is, to the best of our knowledge, the first case of mercury intoxication due the transmission of a mercury-containing cream by skin-to-skin contact. Furthermore, the cream was advertised as a facial cream and not, as in other case reports, as a skin-lightening cream. To our knowledge, there are no studies that addressed the retention of mercury-containing creams on the skin and it is unknown how much mercury can be transmitted by skin-to-skin contact. Nevertheless, this case clearly demonstrates that this route of exposure may lead to severe mercury intoxications and shows that the consumers of mercury-containing creams not only threaten their own health, but also, although unknowingly, endanger their families and friends.

**Declarations**
Ethics approval and consent to participate: not applicable for this case report, since it is a clinical case report of a regular inpatient including state of the art treatment. Only the source of the intoxication is unique.

Consent for publication: The caretakers were informed about the publication. The parents did read the manuscript, and signed the consent form, which is stored in the file of the patient.

Availability of data and material: The clinical data is fully confidential and since it is only one single patient cannot be released.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions:

SR performed the mercury analyses in blood, urine, hair, dust and ambient air, drafted the initial manuscript, and reviewed and revised the manuscript.

EA, SL and JP were responsible for the patient's medical treatment and initial mercury analyses at the Klinikum Dritter Orden and reviewed and revised the manuscript.

SB, DN and SBOR were responsible for the family's medical examination at the LMU University Hospital, and reviewed and revised the manuscript.

All authors read and approved the final manuscript

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This case was reported to the “Bundesinstitut für Risikobewertung” (Federal Institute for Risk Assessment, BfR, Germany), the responsible authority for poisoning incidents in Germany.

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