Case report

Chemical burn following 50% trichloroacetic acid for acne: Presentation of a case and a focused review

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Abstract

Background: Chemical peels are widely used minimally invasive procedures with both cosmetic and medical indications. Although known for their general safety and efficacy, peels can rarely result in significant complications.

Objective: Here we report the first case in the peer-reviewed literature of chemical burn from erroneous home use of 50% trichloroacetic acid.

Methods: A focused literature review was performed of complications relating to chemical peels.

Results: Chemical burns from trichloroacetic acid peels are rare. To our knowledge, this is the first such case reported with supporting histopathological data.

Conclusions: Physicians must be aware of the potential complications of chemical peels, prevention strategies, and treatment modalities.

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Keywords: Trichloroacetic acid; TCA; Chemical burn; Adverse event; Chemical peel; Hyperpigmentation

1. Introduction

The use of chemical peels to improve the appearance and quality of skin has been described as early as 1550 BC in the Egyptian Papyrus Ebers (Bryan, 1974). Ancient Egyptian women, most famously Cleopatra, were known to bathe in sour milk to soften the skin. Since the 19th century, dermatologists have made use of various chemical agents to perform peels as a treatment for acne, pigmentary changes, actinic keratoses, and photoaging. In 2000, the chemical peel was the most popular minimally invasive cosmetic procedure with over 1 million treatments performed. Although this number has remained stable, in recent years peels have been surpassed by the rapid growth of botulinum toxin and soft tissue filler procedures (American Society of Plastic Surgeons, 2013). Trichloroacetic acid (TCA) holds an important place in the assemblage of chemical peeling agents, and is widely known for its safety and reliability. However, its use is highly technique-dependent and results rely heavily on the operator. TCA is frequently used dependably by the experienced...
practitioner, and there is a relative dearth of reports of complications related to TCA peels. Here we present a case of improper home usage of 50% TCA by a patient resulting in chemical burn. There are no similar reports in the peer-reviewed literature involving this strength of TCA, nor are there previously published histopathological data to support this unique complication. We also review adverse events related to chemical peels in the English literature.

2. Case synopsis

A 38-year-old Asian male with Fitzpatrick Phototype IV skin was using 10% TCA at home for treatment of acne. Seeing that his acne was improving with this regimen, he sought to achieve faster and more dramatic results. The patient then purchased 50% TCA online and applied it to his face. Upon application he felt severe stinging and noted white frosting of the skin. He tried to wash off the TCA with cold water; however, over the next few days, noticed that his skin began to change color. He presented to clinic for a consultation and evaluation 4 days after using 50% TCA. On examination of his face (Fig. 1) there was intense hyperpigmentation of the skin with an almost ecchymotic color, and sharp lines of demarcation. The skin was non-tender and no hyperkeratosis or peeling was noted. A biopsy was performed of skin from an involved area on the forehead near the hairline.

The microscopic specimen showed necrosis of the superficial spinous layer as well as focal full-thickness epidermal keratinocyte necrosis (Fig. 2). There was a mild superficial perivascular lymphocytic infiltrate with few neutrophils and eosinophils. Also, there was pigment found within many of the necrotic and remaining viable keratinocytes, likely contributing to the clinical findings. There was focal dermal pigment incontinence with few melanophages found in the papillary dermis. In addition, much of the epidermal pigment within the necrotic and remaining keratinocytes was retained. The histopathological findings correlated well with a chemical burn following TCA exposure.

3. Clinical course

This patient was started on a regimen of fluocinolone 0.01% cream, hydroquinone 4% cream, and tretinoin 0.05% cream, as well as aggressive moisturization. He was also instructed to use sun protection by wearing a hat and applying sunscreen every few hours. Unfortunately, this patient was subsequently lost to follow-up.

4. Discussion

TCA is one of the most widely used peeling agents, along with alpha-hydroxy acids (AHAs) and phenol.
Unna first described the action of this inorganic acid on the skin in 1882 (Brody et al., 2000), and several authors soon followed. There are a multitude of indications for TCA peels including photoaging, rhytides, lentigines, actinic keratoses, acne, acne scars, melasma, and dyschromia. TCA works by precipitating proteins and inducing coagulative necrosis of the epidermis and/or papillary dermis. This is followed by sloughing off of the necrotic layers and re-epithelialization via germinative centers of neighboring hair follicles over the next several days. TCA peeling also promotes dermal collagen remodeling, which can continue for months (Nguyen and Rooney, 2000). TCA has a protein dissociation constant (pKa) of 0.52, making it an inherently stronger acid than AHAs (pKa of glycolic acid – 3.83). TCA is self-neutralizing within minutes after application, and appearance of a white frost indicates the endpoint of the peel.

TCA in strengths of 35% or less is used for superficial peeling whereas in strengths of 35–50% it is used for medium-depth peeling. When used alone at the higher concentrations, TCA is less predictable and is associated with an increased risk of adverse events, including hypertrophic scarring (Nguyen and Rooney, 2000). For this reason, TCA at lower concentrations is often combined with other peeling agents to achieve the desired depth while minimizing the side-effect profile. One common approach is to use 35% TCA after Jessner’s solution for treatment of actinic keratoses. Currently, there is a relative scarcity of reports dividing the side-effect profile. One common approach is to use 35% TCA after Jessner’s solution for treatment of actinic keratoses. Currently, there is a relative scarcity of reports following 50% TCA reflects hyperpigmentation, which can continue for months (Nguyen and Rooney, 2000). TCA has a protein dissociation constant (pKa) of 0.52, making it an inherently stronger acid than AHAs (pKa of glycolic acid – 3.83). TCA is self-neutralizing within minutes after application, and appearance of a white frost indicates the endpoint of the peel.

The risk of an adverse event following a peel is directly related to the depth of the peel, which in turn is determined based on the level of injury produced (Table 1). Complications associated with chemical peels can be divided into immediate onset effects, which occur within minutes to hours, and late onset effects, which occur in days to weeks (Nikalji et al., 2012) (Table 2). Our patient’s striking presentation following 50% TCA reflects hyperpigmentation in combination with persistent erythema. Hyperpigmentation is the most common complication occurring after a TCA peel (Nikalji et al., 2012). The mechanism underlying TCA induced hyperpigmentation may be related to the skin stress response system. A recent study suggests that TCA activates the skin stress response system by directly inducing pro-opiomelanocortin and melanocortin-1 receptor production by keratinocytes (Kimura et al., 2012). Persistent erythema is erythema lasting longer than expected for an individual peel (Monheit, 2004). It is often a predictor of scarring, and some authors assert that areas of erythema three weeks after a peel should be viewed as definite precursors to scars that must be treated aggressively (Rubin, 1995).

Several factors predispose patients to hyperpigmentation following chemical peels. Ethnic or Fitzpatrick Phototype III–VI skin is particularly vulnerable to both hyperpigmentation and hypopigmentation. In addition, skin of color responds less predictably to chemical peels, and is more prone to hypertrophic scarring (Roberts, 2004; Salam et al., 2013). These factors preclude such patients from receiving deep peels, and warrant the use of great caution for superficial or medium peels, even by the experienced practitioner (Roberts, 2004; Salam et al., 2013). In addition, use of estrogen containing medications, photosensitizing drugs, and early exposure to sunlight all increase the risk for hyperpigmentation (Nikalji et al., 2012). In the case of our patient, skin type and improper self-administration of high strength TCA were the leading instigating factors. Preventative measures are the most ideal methods for avoiding complications related to chemical peels. Although there is no universally accepted protocol, several authors recommend pre-treating the skin with a combination of a topical retinoid, hydroquinone, and topical steroid applied daily for 2–4 weeks prior to the peel (Roberts, 2004; Salam et al., 2013; Fischer et al., 2010). Nanda et al. (2004) found that pre-peel priming with 2 % hydroquinone was effective in reducing the risk for hyperpigmentation, with similar improvements as those seen with 0.025% tretinoin at 12 weeks post-peel. However, the hydroquinone group had a statistically superior reduction in hyperpigmentation at 6 months. These agents, in addition to rigorous sun protection, are thought to suppress melanocytes (Bulengo-Ransby et al., 1993) prior to the peel and hence prevent hyperpigmentation. Some recommend continuing this regimen post-peel as well for maximal efficacy, and a similar approach is used to treat hyperpigmentation resulting from a peel. For refractory hyperpigmentation, laser treatment may be of benefit.

Table 1
Level of peel, peeling agent, and depth of injury. DEJ – Dermal–epidermal junction.

<table>
<thead>
<tr>
<th>Level of peel</th>
<th>Peeling agent</th>
<th>Depth of injury</th>
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<tbody>
<tr>
<td>Superficial</td>
<td>10–35% TCA, 30–70% AHA</td>
<td>Epidermis +/- DEJ</td>
</tr>
<tr>
<td>Medium</td>
<td>35–50% TCA, combination peels</td>
<td>Papillary/upper reticular dermis</td>
</tr>
<tr>
<td>Deep</td>
<td>&gt;50% TCA, phenol</td>
<td>Reticular dermis</td>
</tr>
</tbody>
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Table 2
Side effects and complications of TCA peels.

<table>
<thead>
<tr>
<th>Immediate onset (minutes to hours)</th>
<th>Late onset (days to weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema</td>
<td>Herpes reactivation</td>
</tr>
<tr>
<td>Irritation</td>
<td>Secondary infection</td>
</tr>
<tr>
<td>Burning</td>
<td>Persistent erythema</td>
</tr>
<tr>
<td>Pruritus</td>
<td>Scarring and milia</td>
</tr>
<tr>
<td>Pain</td>
<td>Delayed healing</td>
</tr>
<tr>
<td>Edema</td>
<td>Aeneiform eruptions</td>
</tr>
<tr>
<td>Blistering</td>
<td>Textural changes</td>
</tr>
<tr>
<td>Photosensitivity</td>
<td>Dyschromia (hyper or hypopigmentation)</td>
</tr>
<tr>
<td>Contact dermatitis</td>
<td>Lines of demarcation</td>
</tr>
<tr>
<td></td>
<td>Atrophy and telangiectasias</td>
</tr>
<tr>
<td></td>
<td>Ectropion and ocular complications</td>
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</tbody>
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Adapted from Nikalji et al. (2012).
In summary, chemical burn is a very rare complication following TCA peels. Here, we report the first case to our knowledge of a chemical burn from 50% TCA presenting with striking dyschromia. This clinical scenario emphasizes the importance of understanding the adverse effects of peeling agents, as well as the differential responses of ethnic skin to these treatments. Finally, physicians must be aware of the accessibility of these chemicals outside of the medical setting, and the potential for misuse.

Conflict of interest

None declared.

Acknowledgement

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References
