

Transient cutaneous hypomelanosis after cryoanesthesia

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Abstract

A superficial skin abscess in a young black female patient was incised after cryoanesthesia with tetrafluoroethane spray. A hypopigmented area was found at the first follow-up visit in the treated skin area; complete repigmentation occurred during the next 4 months. There are no other similar reported cases in the literature. Since long duration and possibly permanent hypopigmentation can occur after cryoanesthesia with tetrafluoroethane, especially in black people, this technique should be used with extreme caution.

Introduction

Topical anesthetics are widely used to reduce pain before injections or to surgically treat an inflamed portion of tissue, but these drugs have a limited efficacy due to poor penetration.¹ The effectiveness of topical anesthesia² can also be prevented by tissue acidosis³ which characterizes acute inflammatory conditions. Cryoanesthesia was introduced to overcome this problem. It has been shown to be practical and effective^{2,4} in relieving pain caused by the injection of local anesthetics, and in performing other procedures on superficial tissues. Furthermore, it does not cause serious side effects.

Cryoanesthesia is commonly used in dermatological practice as well as in other medical branches such as dentistry and acts by determining heat subtraction from tissues. Cryotherapy, a relatively non-invasive method used for the management of post-traumatic and postoperative pain,⁵ and cryosurgery, aimed at removing superficial pathological areas, are based on the same principle.

Cryoanesthesia and cryosurgery involve the formation of ice crystals, initially extracellular (-10°C, -15°C), which damage the cell membrane, and, subsequently, intracellular, which especially damage the mitochondria and endoplasmic cellular reticles and increase the concentration of intracellu-

lar electrolytes.

The destruction of keratinocytes requires a minimum temperature ranging between -30° and -40°C, while melanocytes are much more sensitive and die between -4°C and -7°C.¹

Cold temperatures also cause platelet aggregation and strong vasoconstriction with consequent endothelial damage and the formation of microthrombi. Persistence of this ischemia leads to necrosis of the treated tissue.

Cryosurgical procedures are used in many fields, not only in dermatosurgery, but also in ophthalmology and gynecology. Low cost, easy use and no need for anesthesia make it an effective procedure to be practiced even on an outpatient basis. Liquid nitrogen is currently the most used substance for cryosurgery.^{6,7}

However, tetrafluoroethane is the most frequently used cryoanesthetic substance in dentistry. It is a colorless and non-flammable gas, used as a refrigerant, with a melting point of -101°C and a boiling point of -26°C. It is available in a pressurized spray can whose content evaporates immediately after spraying. Several toxicological studies on humans and animals have shown that tetrafluoroethane is biocompatible.²

At the best of the authors' knowledge, there are no other cases in the international literature similar to the present one, in which temporary hypomelanosis occurred after skin cryoanesthesia.

Case Report

On December 4th, 2018, a 14-year-old female black patient went to the Oral Surgery Unit, due to painful swelling in her left cheek.

The patient's medical history did not reveal she was taking drugs or suffering from any type of pathology; the patient only reported the presence of the swelling for about 7 days.

The extraoral clinical examination showed swelling which was warm to the touch, with tight, edematous, and translucent overlying skin, localized between the angle and the lower margin of the mandible (Figure 1), as well as limited mouth opening. Intraorally, there were edema and tenderness at the level of the partially erupted, mesially inclined lower second molar, as well as distally, in the lower third molar area.

The orthopantomogram X-rays showed the mesially inclined unerupted third molar bud, which impacted against the second molar, hindering its physiological eruptive path.

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During the same examination the patient's parents signed an informed consent form allowing the performance of a skin incision in order to permit abscess drainage and, therefore, its resolution. To this purpose, to ensure effective analgesia of the area to be treated, not otherwise possible by local anesthetic infiltration due to acute inflammation. Both Emla[®] cream (Astrazeneca - 50% Lidocaine and 50% Prilocaine), initially, and Pulpofluorane[®] (Septodont - 96.6% tetrafluoroethane and 3.4% Dimethyl ether), subsequently, were used.

Skin incision was performed 5 seconds after applying Pulpofluorane[®] spray as this causes skin hardening which hinders the blade's action. A linear incision was per-

formed at the most prominent area of the swelling with a n. 11 blade and then purulent drainage was favored by applying digital pressure. With the aid of a Klemmer inserted inside the abscess cavity, debridement of any internal concamerations was also searched. An iodoform gauze, to be replaced every other day, was then inserted into the surgical wound and a flat dressing was finally applied. Antibiotic therapy was also prescribed for 10 days with Amoxicillin and Clavulanic Acid, 1 g every 8 hours, and Metronidazole, 250 mg every 12 hours. After 5 days, the iodoform gauze was removed, a thorough disinfection of the surgical wound was carried out and a flat dressing was applied again. In that occasion, a discolored, hypomelanotic area was immediately detected in the area where cryoanesthesia had been applied for abscess drainage.

Three weeks later, lower third molar bud surgical extraction and second molar surgical uprighting were performed. During the same session, after adequate sliding of the skin in relation to the muscular plane was obtained (Figure 2), the surgical wound was closed with 4-0 Polyglactin 910 sutures for the muscular plane and 4.0 silk sutures for the skin. The hypomelanotic area remained unchanged. Sutures were removed 7 days after surgical extraction and intra- and extra-oral surgical wounds were inspected. Although the cutaneous surgical wound appeared to be completely healed, the hypomelanotic area was still unchanged and monitoring during the following weeks showed a progressive reduction in its intensity. After 4 months, the hypomelanotic area returned to its normal color and only a small scar from the surgical incision remained (Figure 3).

Discussion

In the present case, Pulpofluorane was used for skin surface anesthesia in addition to the anesthetic cream. Unfortunately, the pathological effect of Pulpofluorane on cutaneous melanosis is not commonly known, although tetrafluoroethane has been used as a cryogen for gingival depigmentation,^{8,9} and the Pulpofluorane information pamphlet only reports the pulp sensitivity test and cooling of mixing plates as indications. Given the lack of eschar formation, it is plausible that the non-excessively prolonged effect of cooling and the limited extension of the area under treatment may have determined only a functional shock of melanocytes without causing tissue necrosis, giving rise to the appearance of a hypopigmented area, more evident here due

to the patient's racial origin. Actually, for cryosurgical gingival depigmentation with tetrafluoroethane, this should be applied for at least 30 seconds to the area to be treated and the gingiva becomes necrotic within 24 hours.⁸ Since the destruction of pathological tissue is the goal of cryosurgery for treatment of benign, potentially malignant, and malignant lesions of the skin,⁸ the adverse post-operative effects that this procedure may involve, whether temporary or permanent, including hypopigmentation, alopecia and paresthesia,¹⁰ have little relevance when compared to the therapeutic result. However, the situation is different in the

present case, since the procedure was conservative, the site was the face, and any permanent outcome would therefore have resulted in significant aesthetic damage.

Actually, prolonged exposure to a cryogenic agent causes unwanted necrosis of the epidermis, first producing an area of erythema and edema followed by the formation of an eschar,¹⁰ or simply causes sensory or skin appendage alterations.¹¹ In fact, after freezing, the distribution of melanocytes in the treated area changes, appearing as a hypopigmented area surrounded by a hyperpigmented peripheral halo, despite the presence of functional melanocytes. From the



Figure 1. Frontal view of the swelling.



Figure 2. Skin suture for fistula closure.



Figure 3. Clinical view at a 4-month follow-up visit: an approximately 1 cm scar is still visible, but the skin is normally pigmented.

1986 study by Burge,¹² it emerges that, although melanosomes are not present in the layers of the cryoanesthetized epidermis, it is possible to distinguish functional melanocytes and that the pigmentation can return to normal within a 6-month period.

Contraindications of techniques that use cold are cryoglobulinemia, Raynaud's phenomenon, blood dyscrasias and immunosuppression,¹⁰ conditions in which the cold itself is the triggering agent of the most serious clinical manifestations.

Although hypopigmentation and hypomelanosis following cryosurgery and cryoanesthesia are reported as adverse effects, their clinical course is not well-documented in the literature; for example, the freezing/thawing temperature, duration of exposure to the cryogenic agent and the proximity to which it is sprayed in relation to the area to be treated are factors which are theoretically capable of influencing extent and reversibility of skin alterations.

A certain degree of hypopigmentation can therefore also complicate cryoanesthesia, regardless of the drug used, and repigmentation can occur due to the migration of melanocytes from the edge of the frozen area, or the flow of undamaged melanocytes present within hair follicles.

Conclusions

Since the risk of more severe and permanent skin damage exists, it is worth not-

ing that when cryogenics are planned to be used for skin anaesthesia, specifically Pulpo-fluorane, the informed consent form must include information concerning that complication, and cryogenics should be used with extreme caution, especially in black patients, limiting the extension of the treated area, increasing the distance between the spray can and the skin surface, and spraying the cryogen for not more than 5 seconds.

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