

Treatment modalities for allergic reactions in pigmented tattoos

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Summary

Decorative tattoos have become very popular. As a result, a higher number of hypersensitivity reactions are seen, caused by the mostly undeclared tattoo dyes. If local and intralesional therapy with corticosteroids is not effective, total excision was formerly considered the best approach. Selective laser therapy offers an alternative approach for removing the offending pigment. Case reports are used to illustrate the individual treatment options for removal of tattoos.

Introduction

Tattooing of the skin has been performed for centuries for various reasons. Independent of social status, decorative tattoos have become increasingly popular. According to a 1993 study in an American high school, 9 % of students had a tattoo and of those who did not 33 % were considering tattooing [1]. An Australian study revealed that every tenth person had a tattoo, men more often than females [2]. A German poll conducted in 2005 by the public opinion institute Marplan concluded that 11.1 % of Germans (every ninth person) had a tattoo and 6.7 % (every fifteenth person) had a piercing. Here too, tattoos were more popular in men [3]. Intolerance reactions can be caused by any type of exogenous pigment. Allergic reactions occur most frequently towards the red dyes of tattoos [4, 5]. Local and intralesional corticosteroids are available to treat these allergic reactions towards tattoo pigments; for intense granulomatous reactions they are often inadequate. Surgical excision has up to now been the only definitive treatment to achieve permanent relief. Selective laser treatment is a new, often-cited alternative to elimi-

nate the respective dyes. In the following, individual treatment modalities will be presented and critically reviewed based on two cases.

Case I

History

A 43-year old woman noticed increasing redness and strong pruritus in two of her three tattoos. These were done 3 years ago on the left upper arm, 5 years ago on the left lower leg and 8 years ago on the right shoulder. The red pigmented areas of the tattoos on the left upper arm and the left lower leg had become increasingly thick; the green-, blue- and black-dyed areas remained unchanged. In addition to pruritus, increasing pain had recently developed. The pink-colored areas of the multi-colored tattoo on the right shoulder had been asymptomatic. Histology revealed a reactive inflammatory reaction to tattooing. She had a history of atopy.

Clinical features

The multi-colored tattoos on the left arm (rose; Figure 1a) and the left leg (devil; Figure 2a) contained sharply circumscribed, palpable, firm infiltrates

limited to the red areas. The surrounding skin was not inflamed or overheated. The other colored areas were inconspicuous. Histopathology of the excised skin from the left upper arm (Figure 3) revealed pigment deposition in the dermis with a marked lichenoid inflammatory infiltrate.

Allergy diagnosis

Patch test (standard, ointment bases and emulsifiers, dyes, rubber chemical, metals, red tattoo dye): weakly positive (+) reaction to fragrance mix, otherwise negative.

Photopatch test (standard, red tattoo dye): weakly positive (+) reaction to fragrance mix, otherwise negative.

Treatment and outcome

An initial treatment trial of intralesional Dermo-Jet[®] injections (mixture of 0.5 % Meaverin[®] and Volon-A[®] crystal suspension 1 : 1) was undertaken. Multiple treatment courses did not lead to a significant change in the red infiltrated areas nor to a reduction in pruritus. The pain persisted, especially on the leg, restricting mobility. Thus, the tattoo on leg was excised completely and, after



Figure 1: (a) Clinical appearance at initial presentation left upper arm. Infiltrated erythema in red pigmented tattoo (rose). (b) Appearance 5 months after surgery.

conditioning of the wound base, a split-thickness graft performed (Figure 2b). The tattooed rose on the arm was removed by a fusiform excision and repaired by side-to-side closure (Figure 1b). To date, no treatment has been needed for the multi-colored tattoo without red dye on the right shoulder blade. Postoperative results are esthetically satisfactory.

Case II

History

The 39-year old man noticed increasing swelling and occasional pruritus in a

multi-colored decorative tattoo (black-contoured stemmed rose with red blossom) on the left forearm three months after having it done. Other tattoos on both arms without red dyes were not troublesome.

Clinical features

The multi-colored tattoo contained a sharply circumscribed swelling and infiltration of the red pigmented rose bud (Figure 4a, 4b). The non-red areas as well as the further tattoos on both arms were not inflamed. There was no history of atopy.



Figure 2: (a) Clinical appearance at initial presentation left lower leg. Infiltrated erythema in red pigmented tattoo (devil). (b) Appearance 9 months after surgery.

Allergy diagnosis

Prick test (perennial and seasonal allergens, red tattoo dye): negative.

Patch test (standard, red tattoo dye): weakly positive (+) reaction to paraben mix, otherwise negative.

Treatment and outcome

Topical corticosteroids produced no improvement. The inflamed red portion was treated with a Q-switched frequency-doubled Nd:YAG laser at 532 nm (Medlite-Laser®, Continuum Biomedical). Treatment was performed at intervals of 4 to 8 weeks for a total of 10 treatments. Progressive disappearance of the red pigment, significant flattening of the treated areas and reduction of pruritus were observed (Figure 5a, 5b). A systemic flare (hematogenous spread) did not occur.

Discussion

Decorative tattoos often consist of different dyes. Red tattoo dye most frequently causes allergic reactions [4, 5]. Classical tattoo dyes include Indian ink and heavy metal salts, such as mercury, cadmium and chromium. Today, in addition to the inorganic pigments titanium dioxide and ferric oxide hydrate, mainly synthetic organic dyes such as azopigments, chinacridone and phthalocyanine copper complexes are used [6, 7, 8]. In a recently published analysis, aluminum and silicon were frequently found in red tattoo dyes [9]. There is no uniform classification of tattoo dyes to date. As allergic reactions towards tattoos are often delayed by months or years, it is often impossible to procure samples of the original dye, especially since there is inadequate information in the commercial sector and there is great fluctuation in the composition of the dyes [10]. In the literature there have been reports of Koebner phenomenon, lichenoid, granulomatous, pseudolymphomatous and morphea-like histopathological changes [11, 12, 13, 14, 15, 16]. When such reactions are suspected, a skin biopsy should be performed before treatment. Tattoo dye allergy diagnostics are complex and difficult. Prick, scratch and intracutaneous tests are only very rarely performed due to the renewed, persistent exposition to the allergen. Eczematous reactions with hematogenous spread have been reported 24 hours after tattooing [17]. Patch testing with the stan-

dard tray, dyes and metals and, when available, the tattoo dye can be performed [18]. In the literature only isolated positive reactions, for example towards mercury and nickel, have been reported [11, 19]. One possible reason for negative patch tests is that tattoo dyes, in addition to classical pigments such as heavy metal salts, increasingly contain synthetic dyes not available for allergy diagnosis. A further reason is that the responsible pigment in the dermis is presented to local dendritic cells with epidermal Langerhans cells not involved in this mechanism, causing patch tests to remain negative [11]. Another theory states that the dyes are poorly soluble and fail to penetrate to the dermis [20]. Despite possible false negative results, patch testing with the standard tray, dyes and metals should be performed. When a provocation of the allergic reaction by combination with UV radiation is suspected, photopatch testing should be done [8]. To definitively identify the allergen, an intracutaneous test or renewed tattooing of a small area of skin would be necessary. When the clinical presentation is clear, prick, scratch and intracutaneous test should be avoided because of the renewed introduction of the allergen with the possibility of inducing local or systemic reactions [11].

Treatment options reported for removing tattoos are topical or intralesional corticosteroids, dermabrasion using a high-speed diamond fraise, salabrasion, surgical excision or laser treatment with different lasers with varying degrees of success [21, 18, 22]. As dye in decorative tattoos usually extends into the dermis, dermabrasion can lead to scarring and to incomplete removal and thus persistence of the allergen. Scars and hypopigmentation have also been reported for salabrasion. These methods are rarely used today due to side effects and more effective alternatives.

In our first case the patient presented with long-term inflammatory changes in the red areas of two of her three tattoos. After failure of initial intralesional corticosteroids and due to progressive pain, and after intensive counseling, we performed a complete excision of the tattoo on the left lower leg and grafted the defect after wound base conditioning with a split-thickness graft. The result was cosmetically and functionally very satisfactory for the patient. Based on her wishes,

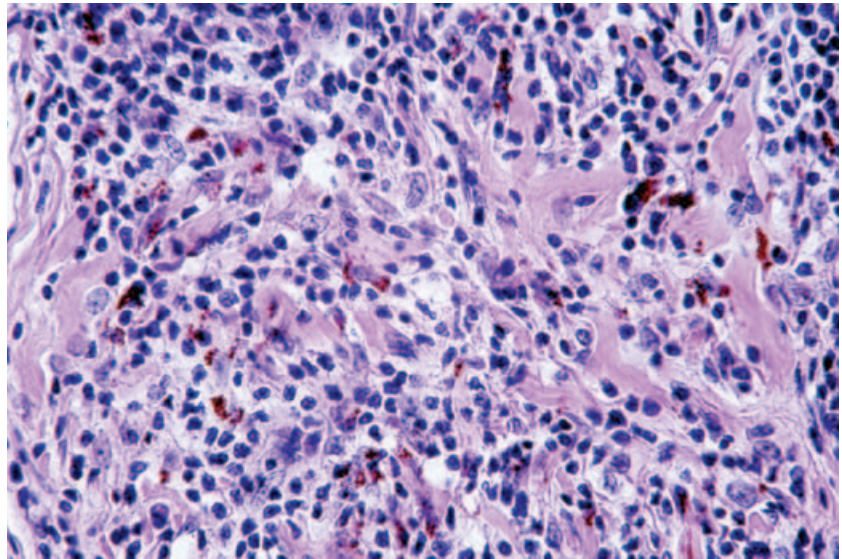


Figure 3: Dermal deposition of pigment and marked lichenoid inflammatory infiltration.



Figure 4: (a, b) Clinical appearance at initial presentation left forearm. Infiltrated erythema in red pigmented tattoo (rose).



Figure 5: (a, b) Post-treatment residual pigmentation after 10 treatments with Q-switched Nd:YAG laser.

only the red blossoms of the rose on her upper left arm were excised in a fusiform fashion. Often, when topical or intralesional corticosteroids are unsuccessful and laser therapy does not appear promising, only radical surgical excision of the

area remains [23]. In the literature, especially when there is hematogenous spread of contact dermatitis towards red tattoo dye, excision is preferred [11, 19, 24]. In our second case with a less inflammatory component, we performed laser

therapy of the red pigmented, markedly raised portions using a Q-switched frequency-doubled Nd:YAG laser at 532 nm. The extremely short pulsed (Q-switched) laser system acts on the principle of selective photothermolysis. Here, the thermal destruction of specific targets occurs by choice of a specific, selectively absorbed wavelength and a very short impulse duration. The Q-switched Nd:YAG laser emits, on the one hand, infrared light (1064 nm) with an impulse duration of between 5 and 20 ns. Due to its deep penetration, is well absorbed by black pigment [25]. On the other hand, halving the wavelength to 532 nm results in visible green light, which is well absorbed by red colors [26, 27].

After only several treatments with the Nd:YAG laser at 532 nm, pulse duration 5 ns, spot size 3 mm and a maximum energy fluence of 3.5 J/cm², significant flattening of the infiltrated red pigmented portions of the tattoo could be observed. The patient was informed of possible side effects such as hematogenous spread. This has not occurred. Low-dose prednisolone and cetirizine were administered prophylactically. With good elimination of the red tattoo dye with the Nd:YAG laser, treatment was continued for 10 sessions. At the end of treatment the result was objectively and subjectively good. The initially infiltrated areas were flattened to skin surface level. The slight pruritus at the outset disappeared completely. The remaining dye is totally asymptomatic.

Removal of tattoo dyes with four different laser systems is described in the literature (Table 1) [28]: 1. Q-switched ruby laser (694 nm) and 2. Q-switched alexandrite laser (755 nm), especially useful for removal of black, blue and green pigment, 3. Q-switched Nd:YAG

Table 1: Response of different tattoo dyes to various Q-switched laser systems [28].

Tattoo dye	Ruby (694 nm)	Alexandrite (755 nm)	Nd:YAG (1064 nm)	Fd Nd:YAG (532 nm)	PLDL (510 nm)
Red	-	-	-	+	+
Black/blue	+++	+++	+++	-	-
Green	++	++	+/-	-	-

Fd Nd:YAG: frequency-doubled Neodymium:YAG laser

PLDL: pigmented lesion dye laser

laser (533, 1064 nm) used particularly to remove red and black pigment, and 4. flashlamp-pumped pulsed dye laser (510 nm) for removing red dye [29, 30, 31, 32, 33, 34]. Textural changes, scarring, color shift and hypopigmentation have been reported as unwanted effects of the ruby laser [35, 31, 15, 34]. Patients treated with the alexandrite laser may develop transient hypopigmentation and textural changes in the tattoo area [36]. With use of the frequency-doubled Nd:YAG laser, hypopigmentation may result from absorption of the wavelength 532 nm by melanin [25]. Color shift due to laser treatment is more frequently observed in brown or skin-colored dyes as compared to red dyes [37].

For removal of black tattoos very good treatment results are reported for the Q-switched Nd:YAG laser (1064 nm) without color shift or scarring [38, 35, 34]. Successful removal of red tattoo dyes using the pulsed dye laser at a wavelength of 510 nm has been reported. Scarring or color shift did not occur [29]. Efficient removal of red tattoo dye using a combination of Nd:YAG laser and pulsed dye laser was recently performed by a team in Philadelphia. Treating the red portion (ferric oxide and titanium dioxide) with the Q-switched Nd:YAG laser first led to a color shift to blue-black, which could nearly completely be removed using the wavelength 1064 nm. The pulsed dye laser was used to remove the fine pink-dyed areas [39]. A safe and effective method to treat lichenoid reactions in red tattoos was reported for the combination of Nd:YAG laser and topical application of clobetasol propionate 0.05 %; this led to flattening and depigmentation of the red dye [40].

Diverse case reports document allergic reactions following laser treatment of tattoos. One possible explanation is that the tattoo dye is initially located intracellularly and enters the extracellular compartment following laser therapy. There, the immune system recognizes it as foreign and macrophage activation results in the clinical reaction [41]. The development of local or generalized allergic reactions is a rare complication of tattoo removal with Q-switched ruby or Nd:YAG lasers [35]. Should it occur, therapy can be continued using corticosteroids and antihistamines as pre-treatment [42]. In multi-colored tattoos lasers of differing wavelengths should be

employed to optimally treat the varying combination of dyes [35, 39].

In allergic reactions to tattoo dyes, a treatment trial of a Q-switched laser should always be considered. Using a Q-switched Nd:YAG laser flattening and lightening of the red infiltrated areas can be achieved after only several sessions. In addition to reduction of swelling and of possibly present pain in the tattooed area, pruritus is usually also decreased. Furthermore, the applied and desired decorative tattoo can usually be largely spared by laser treatment.

Complete surgical excision of the tattoo may represent the last resort, but can be a good esthetic solution. This is especially true for small tattoos which can be removed with good cosmetic and functional results in local anesthesia. For surgical removal of large tattoos either several serial excisions are needed or complete excision followed by wound base conditioning and grafting is performed. For each treatment modality intense counseling of the patient with regards to treatment options, expected results as well as complications and side effects is mandatory. <<<

Conflict of interest

None.

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