Case Report

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Conjunctival tattoo with inadvertent ocular globe penetration and vitreous involvement: Clinico-pathological correlation and scanning electron microscopy X-ray microanalysis

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Abstract

Purpose: The aim is to report a case of conjunctival tattooing with inadvertent injection of tattoo ink into the vitreous cavity and its consequences, the scanning electron microscopy X-ray microanalysis of the ink components, and the microscopic findings of the affected conjunctiva and vitreous.

Methods: Descriptive case report.

Results: A 32-year-old man complained of ocular pain and blurred vision after undergoing a subconjuctival red ink tattoo in his left eye. Ophthalmologic examination revealed best corrected visual acuity of 20/80 and intraocular pressure of 26 mmHg. Pain was elicited with eye movements. The bulbar conjunctiva was colored intense red. In the anterior chamber, pigment granules and filaments were suspended on the aqueous humor, and lens capsule was also stained red. Ultrasonography showed high-density non-mobile echoes in the conjunctiva; anterior chamber and vitreous cavity revealed high-density mobile echoes corresponding to pigment particles. Conjunctival tattoo with inadvertent globe penetration was the clinical diagnosis. The patient received medical and surgical treatment. Histopathological examination of the conjunctiva showed red pigment globular deposits within the stroma, and neutrophils and sparse histiocytes with similar intracytoplasmic pigment granules were seen. No granulomatous foreign body reaction was noticed. Vitreous material contained pigment granules; no inflammatory cells were observed. Scanning electron microscopy X-ray microanalysis of the tattoo red ink revealed significant signals of iron, barium, and copper.

Conclusion: Conjunctival tattoo is a new form of body decoration gaining worldwide popularity. This procedure is performed by untrained professionals causing severe ocular complications including blindness. Safety regarding tattoo ink needs further study as the composition varies among colors. Strict regulations on this matter should be considered.

Keywords

Conjunctival tattoo, eyeball tattoo complications, tattoo ink, inadvertent ocular globe penetration, SEM X-ray microanalysis

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Introduction

The tendency to inject subconjunctival ink has emerged as an extreme and rare form of body modification within the community of people who use tattoos as body decoration.

Although corneal tattooing is an ancient practice used for cosmetic purposes in opaque corneas with poor visual potential and corneal scars,[1] "eyeball tattooing" (conjunctiva and episcleral tattooing) was first described in 2007 by the Body Modification Ezine.[2] This procedure consists of multiple injections of subconjunctival ink to color the whole eye surface, frequently performed by artists with no medical training, increasing the risk of serious complications like globe penetration, traumatic cataract, retinal detachment, and endophthalmitis.[2,3]

Tattoo ink contains different pigments and molecules. Unfortunately, inks are classified as being of "artistic nature" so artists are not forced to inform the exact type of ingredient they contain. Limited information regarding the mechanism that inks generate on eye structures is known; it may vary between colors and brands.[4]

We present a case of inadvertent injection of tattoo ink to the vitreous cavity and its consequences, scanning electron microscopy (SEM) X-ray microanalysis of the ink components, and the microscopic findings of the affected conjunctiva and vitreous.

Case presentation

A 32-year-old Mexican man presented complaining of sudden ocular pain and blurred vision after undergoing subconjuctival red ink injection on his left eye (OS) in a tattoo studio the previous day and after a successful application of subconjuctival black ink tattoo on the right eye (OD). The pigment used in both eyes was conventional skin tattoo ink. History of marihuana and cocaine use were mentioned. Ophthalmologic examination revealed best corrected visual acuity (BCVA) 20/25 on the OD and 20/80 on the OS. The intraocular pressure (IOP) was 14 mmHg in the OD and 26 mmHg in the OS. Anterior segment findings of the OD showed black-colored conjunctiva, transparent cornea, and anterior chamber (AC) with no inflammation. The rest of the exam was unremarkable (Figure 1(a)). In the OS, pain was elicited with eye movements, but without restriction of the gaze positions. Superior and inferior temporal quadrants of the ocular surface displayed red ink. In the AC, red pigment granules and filaments were suspended on the aqueous humor. Details of angle structures were not visible by gonioscopy. The pupil was non-reactive to light because of iris, ciliary body, and AC with unspecific inflammatory response. The anterior lens capsule was stained red (Figure 1(b)).

The OS ultrasound biomicroscopy and B-scan ultrasonography showed high-density non-mobile echoes in conjunctiva. The AC and vitreous cavity revealed high-density mobile echoes corresponding to pigment particles (Figure 2).

Figure 1. Right (a) and left (b) eyes displaying black and red subconjunctival ink, respectively.

Conjunctival tattoo with inadvertent globe penetration and intraocular inflammation of the OS was the clinical diagnosis. Topical anti-inflammatory, antibiotic, and cycloplegics were administered. Prophylactic oral antibiotics with systemic steroids were also prescribed. After 48 hours of unsteady ocular condition, the patient was hospitalized and OS *pars plana* vitrectomy (PPV) was performed as an initial surgery, and previous lavage of the AC was not documented. The penetrating entry site was in the temporal-inferior quadrant and a surrounding laser barricade was applied. Air-fluid exchange was done and SF6 gas at 20% was injected. Vitreous sample and a red stained bulbar interpalpebral temporal conjunctiva fragment were sent to the Ophthalmic Pathology Service.

Histopathological examination of the conjunctiva revealed abundant red pigment globular deposits and neutrophils within the subepithelial stroma. Sparse histiocytes showed similar intracytoplasmic red pigment granules. No granulomatous foreign body reaction was noticed. Conjunctival epithelium was normal (Figure 3(a)).

Vitreous material was exclusively composed of numerous fragmented bright red pigment granules; no inflammatory cells were observed (Figure 3(b)).

SEM X-ray microanalysis of the tattoo red ink revealed significant signals of iron, barium, and copper (Figure 3(c)).

Early post-operative IOP was normal, slit-light examination revealed an inflammatory membrane covering the pupil and multiple ink globules in the AC and over the iris

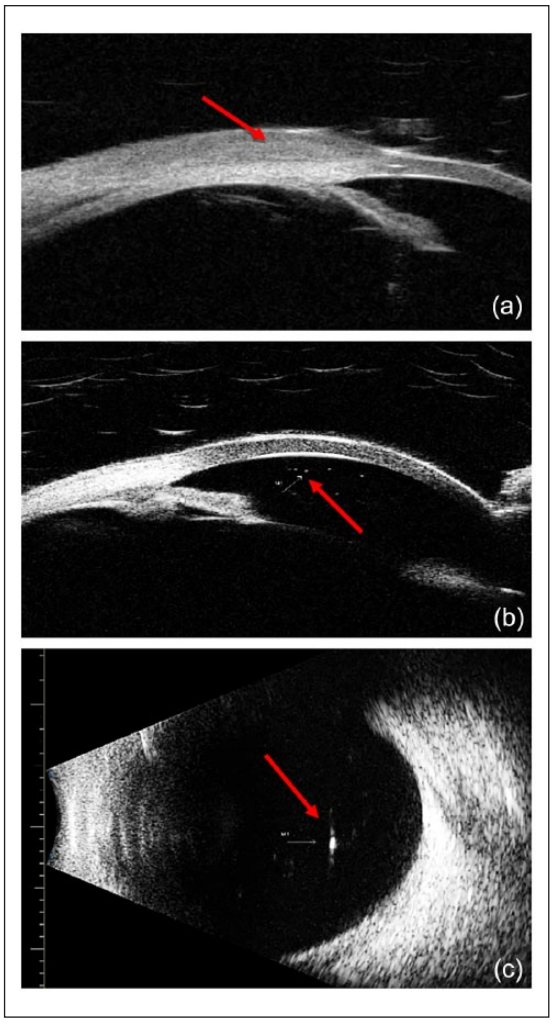

Figure 2. Ultrasound biomicroscopy (a and b) and B-scan ultrasonography (c) of the left eye. Hyperechogenic material corresponding to ink particles (red arrows) is seen in the (a) subconjunctival space, (b) anterior chamber, and (c) vitreous cavity.

surface, and the cornea remained clear. The following week, ocular hypertension developed and persisted, despite maximal topical and oral acetazolamide. As an attempt to remove residual ink particles, a second combined surgical procedure consisted of AC wash out, *pars plana* lensectomy (PPL), and Ahmed valve implant. Patient refused to continue treatment and was lost to follow-up.

Discussion

Most of tattoo inks contain a mixture of potentially genotoxic and carcinogenic organic and inorganic pigments. Polycyclic aromatic polycarbonates, organic colorants, heavy metallic salts, and nanoparticles have been documented.[5] Red and black inks are commonly involved in adverse reactions.[6] Tattoo red ink composition contained predominantly mercuric sulfide which has been discontinued and replaced with cadmium selenide, sienna, ferric hydrate, and organic dyes. Azo dyes are industrially used in printers, as automobile paint, and have replaced metal salts due to their vibrant colors and longevity.[6,7] Tattoo black color is primarily based on carbon soot and may contain hazardous polycyclic aromatic hydrocarbons that induce cytotoxic effects.[6,7]

In addition to the pigments themselves, propriety ingredients, diluents, and preservatives are used to stabilize the inks. These are sometimes identifiable through the material safety data sheets provided by tattoo-ink manufacturers, although often no list of ingredients is provided. The safety of pigments used in modern tattoos is unknown and requires further studies.[4,6]

Eyeball tattoo complications can be divided into two groups as proposed by Tubek et al.:[8] Ink-related and procedure-related.

Procedure-related complications develop following globe penetration with the tattoo needle device. Complications include vitreous or subretinal hemorrhage, retinal detachment, endophthalmitis, and traumatic cataract.[8,9] When ink reaches intraocular structures such as corneal endothelium, lens, iris, ciliary body, trabecular meshwork, vitreous, and retina, worse prognosis is expected.[1,8] Inflammatory reaction and ink particles cause transparency loss, toxicity, and trabecular damage that leads to ocular hypertension and eventual secondary glaucoma.[1,9] Anti-inflammatory, antibiotics, and cycloplegics are indicated. Early removal of intraocular ink residues is recommended as first intention treatment.[8]

Even though our patient had ink deposits in AC and vitreous cavity confirmed by ultrasonography, a vitrectomy was performed as the initial surgical treatment, no initial AC lavage was done, and intensive anti-inflammatory treatment was continued.

The second group of complications is caused by both local and systemic immune hypersensitivity reactions to the tattoo ink used.[8] Few reports have described non-specific clinical findings such as episcleral nodules,[3] posterior scleritis,[3] orbital cellulitis,[3] conjunctival swelling,[2] and conjunctival lump[2,8] after having an eyeball tattoo. Interestingly, a case series of seven patients with skin tattoos and coincident onset uveitis has been described. Five of them suffered potentially vision-threatening ocular complications, and variable resolution was observed after skin tattoo excision.[10] These supports that removal of ink residues is recommended for resolution of the clinical picture. If skin tattoos can induce uveal reaction to pigments, subconjunctival ink injection may result in more frequent or more severe uveitis. Since complete removal of the episcleral pigment deposit is technically impossible, this treatment becomes limited in patients with eyeball tattoos.[8]

Another ink-related complication is a persistent chronic immune reaction which can favor carcinogenesis and malignancy development.[2,7] Inflammatory reaction is probably not the only factor, but tattoo inks also contain potentially hazardous and carcinogenic compounds that

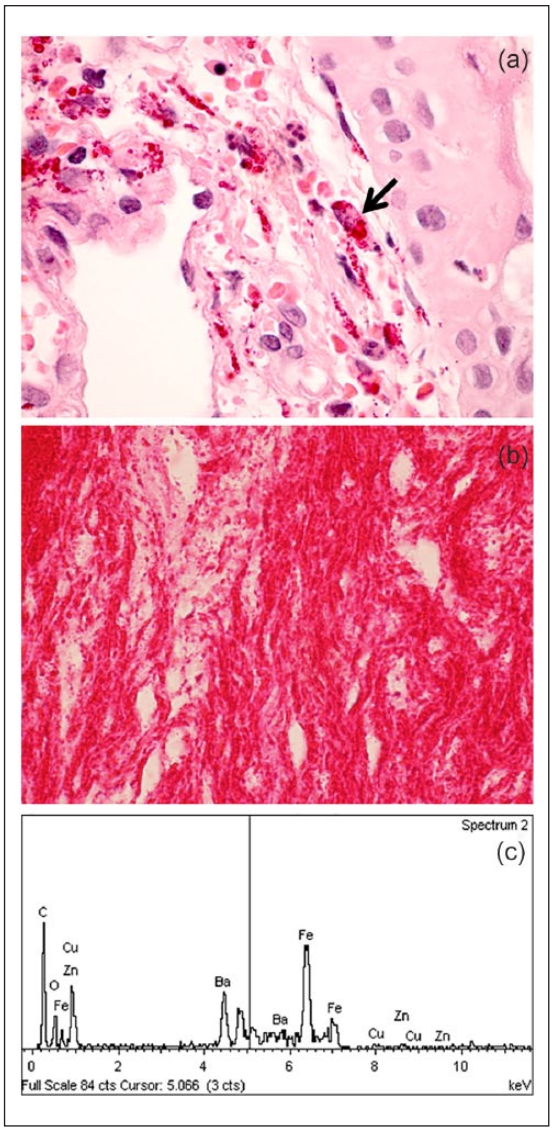

Figure 3. (a) Microscopic examination of the conjunctiva showed numerous red pigment globular deposits. Inflammatory cells contained similar intracytoplasmic red pigment granules (arrow) (H&E, × 100). (b) Vitreous material revealed multiple diminute pinkish-red particles; no inflammatory cells were observed in any slides (H&E, x40). (c) Scanning electron microscopy (SEM) X-ray microanalysis of the tattoo red ink demonstrated significant signals of iron, barium, and copper.

hypothetically could be tumorigenic. Cutaneous malignancies such as basal cell carcinoma, squamous cell carcinoma, and leiomyosarcoma have been reported associated to skin tattoos. Melanoma can arise within tattoos, and clinical diagnosis can be difficult by the presence of surrounding tattoo areas that can resemble melanin pigment.[7]

The histopathological patterns in cases of cutaneous reactions following tattoos include eczematous, lymphohistiocytic, lichenoid, granulomatous, sarcoidosis-like, and pseudo-lymphoma.[7] Microscopic examination of the affected conjunctiva revealed red pigment granules and neutrophils in the conjunctival stroma; accompanying histiocytes showed similar intracytoplasmic red pigment particles. No specific histopathological pattern was identified surely because the biopsy was taken within days from the inadvertent injection and this is too short a time to develop a more specific inflammatory reaction. Vitreous material contained fragmented bright red pigment granules, and no inflammatory cells were identified. Our findings were consistent with a case with blue eyeball tattoo informed previously.[9] The SEM X-ray microanalysis of our patient revealed iron, barium, and copper in the red ink. A similar microanalysis done in blue ink revealed titanium, oxygen, copper, chlorine, and nitrogen.[9] Currently, the US Food and Drug Administration neither approves nor regulates any tattoo inks because they are considered of cosmetic use.[6]

Eyeball tattoo is gaining popularity worldwide, resulting in potentially blinding complications. Ophthalmologist should be aware of this sight-threatening cosmetic procedure performed by non-medical trained practitioners.

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