Case Study

Ocular Argyrosis in a Silver Craftsman

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Silver (Ag) is a rare, naturally occurring element. Because of its physical properties (hardness, ductility, malleability, high thermal and electrical conductivity) and antimicrobial activity, Ag has been extensively mined and utilized since antiquity in a wide variety of applications, including metallurgy, soldering, electroplating, photography, medicine and dentistry (wound and burn care, surgical devices, dental amalgams), water sanitation, cosmetics, electronics, production of coins, medals, jewellery, silverware and mirrors1,2).

Small Ag quantities are absorbed by humans through diet, even though the element fulfils no physiological role in any human tissue. In the case of occupational or iatrogenic exposure, Ag is less toxic than other xenobiotic metals (such as lead and mercury) and the most common clinical presentations are argyria (slate gray discoloration of the skin and other soft tissues, due to generalized accumulation of the metal) and argyrosis (discoloration of the eye, skin and/or external mucous membranes, caused by local Ag absorption and deposition). Additionally, soluble Ag compounds may cause liver and kidney damage, irritation of the eyes, skin, respiratory and intestinal tract, and haematological changes2,3).

Thanks to the improvement of hygiene in the workplace, and to the restrictive use of Ag-containing medications, Ag-related disorders are uncommon in current clinical practice. We describe here the clinical and pathological findings of an exceptional (nowadays) case of occupational argyrosis diagnosed in advanced age.

Case Presentation

The subject was a 71-yr-old man, working from the age of 17 as a craftsman producing a variety of Ag articles, including vases, plates, trays and frames. These articles were created by cutting, welding and hammering Ag sheets and leaves into the desired shapes. Subsequently, they were polished and re-silvered in a galvanic bath. The working bench was situated approximately 30–40 cm from the subject’s face, who never wore any ocular or respiratory protective devices. No aspiration systems were present in the workplace. The patient used to work up to 8 h daily, alternating crafting with the selling of the articles. His producing activity had gradually diminished during the last few years. He never used Ag-containing medications.

When the worker first came to our observation, his urinary Ag concentration was 0.10 µg/l (0.15 µg/24 h), i.e. within the reference range (0.04–0.88 µg/l) for the general Italian population4). No previous environmental or biological monitoring data were available.

The patient reported that his vision (both proximal and remote) had worsened during the last few months. He did not complain of nyctalopia or other subjective visual symptoms. General medical history and physical examination, routine blood/urine analysis, electrocardiography, and chest radioimaging were unremarkable. Ocular examination revealed a bilateral, marked blue-gray discoloration of the tarsal and bulbar conjunctive (Fig. 1), and of the cornea (Fig. 2). No abnormal pigmentation of the skin or other external mucous membranes was noted. Natural visual acuity (not susceptible to improvement with lenses) was 5/10 in the right eye and 4/10 in the left. Besides corneal discoloration, slit-lamp examination of the anterior segment disclosed bilateral, nuclear sclerotic cataract, without pigment deposition. In vivo confocal microscopy showed highly reflective material with a granular pattern in the deep layers of both corneas, anterior to the endothelium (Fig. 3). Because of this diffuse structural alteration, endothelial cell count was impossible. The corneal thicknesses (measured by ultrasound pachymetry), intraocular pressures, visual fields (evaluated by Humphrey computed perimetry), and retinal appearances at fundoscopic examination were normal.

A biopsy was obtained from the bulbar conjunctive of the right eye. Histopathological examination revealed a normal non-keratinizing squamous epithelium and deposits of a dark granular pigment in the submucosa (Fig. 4). No atypia or inflammation were observed.

The study was conducted with the patient’s informed consent. Both the University of Pavia and the Salvatore Maugeri Foundation follow the Declaration of Helsinki in conducting medical research involving human subjects.

Final diagnosis was occupational, bilateral
**Fig. 1.** Ocular argyrosis (top: external photograph of the left eye; bottom: detail of the right eye). The conjunctival pigmentation is most prominent on the temporal side, around the cornea, at the inferior fornix, and over the lachrymal caruncle.

**Fig. 2.** Slit-lamp images of cornea. Frontal view (top): diffuse and punctiform blu-gray discoloration. Lateral view (bottom): stromal and Descemet’s membrane localization of the deposits.

**Fig. 3.** Confocal biomicroscopic corneal image (left eye) showing diffuse hyperreflective granules.

**Fig. 4.** Section of the bulbar conjunctive showing brown-blackish granular deposits in the submucous tissue, mainly along the endothelial basal membranes (haematoxylin-eosin stain; original magnification × 100).
conjunctival-corneal argyrosis without systemic intoxication. Ag exposure was stopped. No specific treatment was proposed. The case was referred to the Italian Workers’ Compensation Authority.

**Discussion**

Ocular argyrosis used to be caused mainly by prolonged application of colloidal Ag eye drop preparations (e.g., argyrol, protragrol), utilized as disinfectants. Since these eye drops are no longer used, argyrosis is now a rare occupational disease, essentially caused by inadequate ocular protection in the workplace. Systemic Ag absorption through the lungs has also been suggested to play a role. Ag accumulation in eye tissues has been described in engravers and polishers, solderers, photographers and photochemists, and in industrial workers producing Ag-containing compounds. In exposed workers, the amount of Ag deposits, and the degree of ocular discoloration, correlate with the length of employment.

No information was available on the Ag concentration, size and form in the working environment of our patient. During the 1970s, Italian Ag polishers working in comparable conditions were found to be exposed to 0.31 mg/m³ of Ag metal dust. As in our case, their urinary Ag excretion was the same as that of the general population, and they presented deposits on the conjunctiva and/or the cornea, without generalized argyria. This is not surprising since metallic Ag and insoluble Ag compounds are not readily taken up by the body, and are less toxic than soluble Ag compounds. Accordingly, the American Conference of Governmental Industrial Hygienists (ACGIH) has established separate threshold limit values for metallic (0.1 mg/m³) and soluble (0.01 mg/m³) Ag.

Occupational argyrosis usually involves both eyes. An exceptional unilateral case was described in a photographic laboratory technician, suffering from nyctalopia and a decrease of visual acuity, as well as other causes of abnormal eye pigmentation, such as malignant melanoma and deposition of heavy metals (iron, copper) or drugs (ciprofloxacin, amiodarone). In this regard, confocal microscopy is valuable for real-time, non-invasive observations of the cornea in various pathologic conditions. Several reports exist on its use for the evaluation of corneal deposits, as recently reviewed by Sánchez-Huerta et al., who firstly utilized this diagnostic tool in four cases of occupational argyrosis. Both in Sánchez-Huerta’s study and in the present case, Ag deposits appeared as diffuse hyperreflective dots in the posterior stroma (with no endothelial involvement), suggesting that confocal biomicroscopy may provide important information for the diagnosis of corneal argyrosis.

It is controversial whether ocular argyrosis is associated with nyctalopia and a decrease of visual acuity, as well as other causes of abnormal eye pigmentation, such as malignant melanoma and deposition of heavy metals (iron, copper) or drugs (ciprofloxacin, amiodarone). In this regard, confocal microscopy is valuable for real-time, non-invasive observations of the cornea in various pathologic conditions. Several reports exist on its use for the evaluation of corneal deposits, as recently reviewed by Sánchez-Huerta et al., who firstly utilized this diagnostic tool in four cases of occupational argyrosis. Both in Sánchez-Huerta’s study and in the present case, Ag deposits appeared as diffuse hyperreflective dots in the posterior stroma (with no endothelial involvement), suggesting that confocal biomicroscopy may provide important information for the diagnosis of corneal argyrosis. It is controversial whether ocular argyrosis is associated with nyctalopia and a decrease of visual acuity, as well as other causes of abnormal eye pigmentation, such as malignant melanoma and deposition of heavy metals (iron, copper) or drugs (ciprofloxacin, amiodarone). In this regard, confocal microscopy is valuable for real-time, non-invasive observations of the cornea in various pathologic conditions. Several reports exist on its use for the evaluation of corneal deposits, as recently reviewed by Sánchez-Huerta et al., who firstly utilized this diagnostic tool in four cases of occupational argyrosis. Both in Sánchez-Huerta’s study and in the present case, Ag deposits appeared as diffuse hyperreflective dots in the posterior stroma (with no endothelial involvement), suggesting that confocal biomicroscopy may provide important information for the diagnosis of corneal argyrosis. It is controversial whether ocular argyrosis is associated with nyctalopia and a decrease of visual acuity, as well as other causes of abnormal eye pigmentation, such as malignant melanoma and deposition of heavy metals (iron, copper) or drugs (ciprofloxacin, amiodarone). In this regard, confocal microscopy is valuable for real-time, non-invasive observations of the cornea in various pathologic conditions. Several reports exist on its use for the evaluation of corneal deposits, as recently reviewed by Sánchez-Huerta et al., who firstly utilized this diagnostic tool in four cases of occupational argyrosis. Both in Sánchez-Huerta’s study and in the present case, Ag deposits appeared as diffuse hyperreflective dots in the posterior stroma (with no endothelial involvement), suggesting that confocal biomicroscopy may provide important information for the diagnosis of corneal argyrosis.
In conclusion, this case report highlights the hazard of Ag crafting without adequate eye protection, and indicates that occupational ocular argyrosis may still be observed in clinical practice today. In such cases, occupational anamnesis, ophthalmologic examination, confocal corneal biomicroscopy, and histopathology will allow the correct diagnosis that, in turn, is important for work-related medico-legal issues.

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