MIGRATION OF INTRA-OCULAR FOREIGN BODIES*

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THE migration of an intra-ocular foreign body, with or without its subsequent spontaneous extrusion from the eye, has been reported several times in the literature, though in few instances in any detail. It was first described by de Castelnau (1842), who recorded how a man sustained an injury to his right eye, followed, $3\frac{1}{2}$ years later, by the spontaneous extrusion through the cornea of a particle of iron measuring 13 mm. $\times$ 5 mm., and weighing 750 mg. His treatment of the eye during recurrent periods of inflammation while the foreign body was retained included cold compresses, leeches, and belladonna.

Copper particles, however, are the most frequently concerned in this phenomenon. De Wecker (1896) noted a case in which, immediately after an injury, a foreign body was seen ophthalmoscopically in the right fundus near the macula. At the end of 4 weeks it was seen in the lower part of the vitreous, and its life-history, although complicated by the removal of a secondary cataract, was terminated only after it had perforated the iris and cornea some $4\frac{1}{2}$ years later. Blake (1931), the only writer to give details of an accurate x-ray localization, reported two cases, in each of which a piece of copper-wire migrated forwards; in the first, a piece of wire $3\frac{1}{2}$ mm. long moved in the course of 5 years from a position "5 mm. behind the cornea" to the limbus in the six o'clock meridian; in the second, a piece of wire $5 \times 2 \times 2$ mm. moved from a position "4 mm. below the horizontal, 5 mm. to the temporal side of the vertical plane, and 10 mm. behind the cornea", to the limbus, again in the six o'clock meridian. This latter case, however, was operated on unsuccessfully, when the foreign body was seen to be pushing the iris forwards, so that its history was not straightforward. Other cases in which migration followed by extrusion occurred between 1 and 5 years after injury have been noted by Kipp (1884), Rampoldi (1891), Meyer (1894), Hoesch (1895) and Erb (1899). A 7 to 10 year delay was reported by Hartley (1883) and Spechtenhauser (1894), 18 years by Lewis (1897), and 21 years by Raulin (1897). Kümmell (1908) reported a case in which a copper particle weighing 2.75 mg. and measuring $1.6 \times 1.3 \times .85$ mm. moved from the upper posterior part of the globe until it caused the iris to bulge forwards; an iridectomy including the foreign body was performed, with a satisfactory result.

*Received for publication August 16, 1955.

The migration and extrusion of iron particles have been reported by Gesang (1905) and Scalinci (1905), of glass by Azarova (1943) and Gandolfi (1947), of wood by Bochever (1947), and of a lead pellet by Wicherkiewicz (1904).

Case Report

A male brass-worker, aged 49 years, was admitted to hospital on December 23, 1952.

History.—10 days previously he had been removing a short pipe from a cylinder block. The pipe was composed of an alloy with a high copper content, and this was being struck by an engineer's hammer and a sharp cross-cut steel chisel, instead of the usual blunt-ended tool known as a "drift". While at work he felt something strike the right eye and, as the presence of an intra-ocular foreign body was not suspected at first, he was treated merely for a corneal abrasion, but after a few days the eye became painful and the vision blurred, so he was referred to hospital.

Examination.—On admission, the left eye showed no abnormality, with a visual acuity of 6/6. The right eye had a visual acuity of 6/24 unaided. There was a 3-mm. linear perforating corneal wound in the 9.30 meridian, 3 mm. from and parallel to the limbus. There was a localized lens opacity at 9.30, partly obscured by a posterior synechia. The vitreous and fundus showed no abnormality, and the tension was normal. X-ray localization revealed the presence of a radio-opaque foreign body in the region of the pars plana of the ciliary body of the right eye, 9 mm. to the temporal side of the vertical corneal axis, 8 mm. deep to the plane tangential to the centre of the anterior surface of the cornea, with its centre 3.2 mm. below the horizontal corneal axis (Figs 1 and 2a).

Operation—24/12/52.—Under local anaesthesia the lateral rectus was mobilized and a scleral incision made 8 mm. from the limbus, 2 mm. below the mid-line. Repeated magnet applications produced no result, so the wound was closed and the eye allowed to settle down. Further x-ray localization showed no change in the position of the foreign body, and an attempt was made to remove it under direct vision.

Operation—30/1/53.—A scleral flap was prepared and turned back on the temporal side over the site of the foreign body. The ciliary body was incised, but nothing was found, so the wound was closed. There was some vitreous loss.

FIG. 1.—X-ray localization charts for right eye, showing initial and final positions of foreign body.

- (1) Initial position—23/12/52.
- (2) Final position—26/3/55.

(a) 7/1/53.

(b) 11/9/54.

(c) 26/3/55.

FIG. 2.—X rays (lateral view) showing different appearances of foreign body indicating movement.

The eye then settled down again, there were no further attempts at removal, and the patient was discharged on 8/2/53. However, the local lens opacities and also a posterior cortical cataract developed gradually, and there were recurrent attacks of iritis (and hypopyon) necessitating admission for a week in September, 1954. At that time a further x ray was taken, revealing that the foreign body had altered its position (Fig. 2b).

When the patient was seen on 25/3/55 at a routine visit, it was noticed that there was a dark spot $1\frac{1}{2}$ mm. behind the limbus in the 5.30 meridian, and that this was the foreign body embedded in and showing

through the sclera was confirmed by x ray (Figs 1 and 2c). By this time the visual acuity had become reduced to "hand movements", and a mature cataract had developed in a lens slightly displaced backwards below. There was a mild uveitis, and the tension was slightly reduced.

Operation—26/3/55.—Under local anaesthesia a conjunctival flap was fashioned, and turned back, and a 3-mm. scleral incision was made over the point of the foreign body, which was withdrawn with forceps and the wound closed. It was found to have been lying almost horizontally, with one end embedded in the sclera in the 5.30 meridian, $1\frac{1}{2}$ mm. behind the limbus, and the other in the inferior angle of the anterior chamber in the 7 o'clock meridian.

Nature and Route of Foreign Body.—The particle was examined in detail and found to be attracted only very feebly to the giant magnet. It was triangular in cross section at its centre, tapering to a point at both ends, and measured $4.1 \times 1.25 \times 1.16$ mm. (Fig. 3). It weighed 6.96 mg. and analysis showed its composition to be: copper 60.2 per cent. and zinc 39.7 per cent., i.e. 60/40 brass.

In its passage forwards it could have travelled by one of three routes. Having pierced the pars plana, it may have moved forwards in the suprachoroidal space, traversed the ligamentum pectinatum, and then entered the angle of the anterior chamber, or it may have travelled along the surface of the ciliary body and then through the zonule and the root of the iris, or it may have passed through the whole thickness of the ciliary body before entering the anterior chamber, though this last is unlikely.

FIG. 3.—Foreign body.

Discussion

The factors concerned in the migration and extrusion of intra-ocular foreign bodies, and of copper particles in particular, will be noted under four headings:

Size and Shape.—These have been said to have little influence on the tendency of a foreign body to migrate (Blake, 1931), but one would suggest that the opposite is, in fact, the case, for 80 per cent. of copper particles which migrate are long and narrow, with pointed ends and a transverse diameter of 2 mm. or less. It must be admitted that, although they have a similar shape, glass and iron foreign bodies very rarely migrate. In the case of glass, however, the inactive chemical nature of silicates in the eye is the predominant factor, and in the case of iron, the relatively mild inflammatory reaction it produces compared with copper, again on account of its chemical nature, together with the fact that most iron foreign bodies are removed within a short time of their entering the eye, are two factors which greatly reduce the likelihood of such a particle migrating.

Chemical Nature.—Although only about 4 per cent. of intra-ocular foreign bodies are composed of copper, two-thirds of those which migrate contain this metal. It is said that, if copper is present in the form of an alloy containing less than 85 per cent. of the metal, chalcosis tends to occur, whilst, if it is present in relatively pure form, a violent purulent reaction ensues. Leber (1892) first drew attention to this fact in his experimental investigations, wherein he introduced lead, copper, and other metals into the eye, and observed their effects. In the present case, however, although the copper content was only 60.2 per cent., the reaction, while doubtless controlled by treatment, was mainly purulent in type. It is this marked inflammatory reaction which is partly responsible for the migration and eventual extrusion of copper foreign bodies as compared with other types.

Magnetic Properties.—The fact that copper foreign bodies are not ferro-magnetic renders their extraction difficult, so that many are retained. This will increase the proportion of copper amongst other types of migrating particles.

Direction of Movement.—This is always forwards and, in four-fifths of the cases, downwards also. The latter is clearly due to gravity, since, in the waking hours at least, this force will act towards the lower part of the eye-ball, whilst the former is

related to the reaction of the ocular tissues. In other parts of the body, any foreign material will always pass towards a surface, whether the skin (externally) or a body cavity (internally), and this is due to the inflammatory reaction produced around it softening the adjacent tissues, associated with tissue tension, which will drive the foreign body outwards towards a free surface. In the eye the same holds good, the tension of the orbital tissues, together with the intra-ocular pressure, tending to move the foreign body forwards. Occasionally, a particle will migrate to its original entry wound. This is rare, but has been attributed to the contraction of fibrous tissue which has formed along its entry path, pulling it forwards; a more probable explanation is that the entry path is preferentially softened by the inflammatory reaction, thus producing a line of least resistance, along which the particle will travel.

Other reasons which have been adduced for the forward migration of foreign bodies are the compression of the globe by the extra-ocular muscles, the pull of the ciliary muscle on the choroid during accommodation, and the intra-ocular fluid currents. The first of these may play some part by increasing the intra-ocular pressure, but the other two are clearly somewhat fanciful.

Summary

A case is described of the migration of an intra-ocular foreign body composed largely of copper. A summary of the previous literature on the subject is given, together with an explanation of the phenomenon.

My thanks are due to Mr. J. G. Milner for permission to publish this case.

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