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Ocular Foreign Bodies: A Review

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Abstract

A foreign body is any abnormal substance or object that does not belong to the body (eye). The incidence of foreign body in the eye is high especially in the industrial towns. It can occur at any age and in both genders. It affects the eye by mechanical effects, by introduction of infection or by specific reaction. Introduction of a foreign body is a significant disturbance and can create health problem. The study of the foreign body presents unparalleled opportunities for reducing morbidity and for realizing significant savings in both financial and human terms.

This article explains the effects of foreign bodies both extra and intra ocular on the ocular structures, their effects and management.

Keywords: Extra ocular foreign body, Intra ocular foreign body, Ophthalmic cases

Introduction

A foreign body is any abnormal substance or object that does not belong to the body (eye). The incidence of foreign body in the eye is high especially in the industrial towns. It can occur at any age and in both genders.

It affects the eye by mechanical effects, by introduction of infection or by specific reaction. Introduction of a foreign body is a significant disturbance and can create health problem. The study of the foreign body presents unparalleled opportunities for reducing morbidity and for realizing significant savings in both financial and human terms [1-3].

Foreign body in the eye can be extra ocular or intra ocular.

1. Extra ocular foreign body: lid, sclera, conjunctiva and cornea.

2. Intra ocular foreign body: in the angle of anterior chamber, iris lens, vitreous, retina and intra orbital.

Usually the materials of extra ocular foreign body are coal, dust, sand, iron particles, eye lashes, wood piece, husk of seed, wings of insect, etc. The Intra Ocular Foreign Body (IOFB), which penetrate the eye and retained are minute chips of iron or steel, stone, glass, lead pellets, copper, spicules of wood etc., [1,3].

Intra ocular foreign body is one of the causes of monocular blindness because usually it is associated with penetrating or perforating injury of the eye. Adequate history is more important to find out which treatment may be best for a particular intra ocular foreign body. Dramatic improvement in the surgical removal of IOFB has evolved over the past two decades.

Intra ocular foreign bodies [1-3,5]

Approximately one million new ophthalmic cases seen in industrialized cities, found that the incidence of IOFB was about 1 in 1000; the proportion of foreign bodies in all accident cases was in 300 Cridland [1].

Small foreign bodies may leave the main structure of the globe relatively intact. Hard foreign bodies with sharp edges such as pieces of metal, stone or glass form the majority of the second class. If its velocity is sufficiently great, the particle may traverse the structures of the eye causing a double perforation and come to rest in the orbital tissues.

The organic materials which are carried passively into a perforating wound, the commonest are cilia or small pieces of vegetable matter, bits of twig or slivers of wood may enter the eye on their own momentum.

In the domestic surroundings - "motes" of organic metal or dust, textile material ashes, coal-dust, pieces of tobacco, eye lashes etc., are frequent offenders.

In the industry-pieces of metal, emery or stone is most common accident.

In agricultural setting environment-vegetable matter like seeds, husks and flying insects' parts are common.

The foreign body is a flying particle, usually metallic in nature. Iron and steel come first. Majority of the foreign bodies causing such injuries happen in the workshop or in war.

Pieces of stone, rock or coal in industrial accidents, sand, clay or brick dust from explosions, as well as particles of powder and cordite are also occasionally found. Glass fragments are occasionally propelled into the eye as a result of a broken spectacle lens but increasingly this is the result of a shattered windscreen or a broken driving-mirror in traffic accidents. The use of the hand hammers is the major cause of an intra-ocular foreign body; at least 70% of cases arise in this way, mostly among workers in the engineering industry but also in stone masons. Intra-ocular foreign bodies resulting from machining or the operation of power driven tools are less common. The injuries occur sometimes as a result of domestic or sporting activities. They are also met in childhood (14% of perforating wounds in children) [4,5].

Extra ocular foreign body [3,5]

The most common accident encountered in ophthalmology is the retention a foreign body on the surface of the eye. If the foreign material is not automatically removed by the tears, it frequently incapacitates the patients and introduction of infection may cause permanent damage to vision and even occasional loss of eye. The nature and composition of the foreign body are also of extreme importance. Most organic material set up a considerable tissue reaction of the foreign body.

Mechanical effects of foreign body

When the foreign body strikes the cornea, there is a sharp burning pain, a reflex gush of tears with momentary blindness, and the lids close in blepharospasm. The patient rubs the eye violently and often succeeds in impacting the foreign body securely in to the corneal depth whereas, if left alone, it might well have been safely washed down into the conjunctival cul-de-sac. These symptoms are prominent mostly in the upper and middle parts of the cornea. If the foreign body is central, a considerable diminution of vision may result; due not only to the lacrimation but also by creating an optical blur due to irregularity of the corneal surface and corneal edema and folds.

If the foreign material is chemically inert (coal, glass etc.,), it is usually incorporated in the corneal tissues where, it is permanently embedded. If it is irritative and excites chemical reaction in the tissues (iron, copper etc.,] an inflammatory infiltration usually appears as a grey ring. The site is marked by a permanent opacity, when epithelium alone is removed.

In the conjunctiva sharp gritty particles on the inner surface of the upper lid, particularly those lying in the subtarsal fold, continuously abrade the cornea during blinking.

In the sclera impaction of foreign bodies is rare. They are usually found in the palpebral aperture since elsewhere the lids provide adequate protection.

Mechanical effects of retained foreign bodies [3-5]

Most foreign bodies penetrate the eye from before backwards, and the wound of entry is usually in the cornea, at the limbus or in the anterior part of the sclera. The bony orbit adequately protects the posterior part of the sclera. A corneal wound always leaves a permanent mark as full thickness opacity.

In the anterior chamber

A foreign body naturally rests at the bottom of the chamber and if is small it is usually from view lying deep in the recess of the angle underneath the scleral rim where it may be seen only with the gonioscope. If the iris is torn, a small exudation of blood may appear in the tissues around the foreign body as well as a hyphaema in the anterior chamber, while a traumatic iritis is usual. In the ciliary body this reaction is always greater and a traumatic iridocyclitis which eventually leads to atrophy of the globe.

In the lens [2,3,5]

The foreign body is frequently retained in the lens, coming to rest result usually in the dense nucleus, which may vary from localized opacity to a complete opacification of the entire lens.

The posterior segment

The globe may be entered either through the cornea, iris and lens, zonule, or directly through the sclera. In this situation serious complications could arise. If the eye becomes infected, consequences are particularly disastrous. The foreign body may traverse the vitreous and bury itself in the posterior wall of the globe after it ricochets off from the surface of the retina. At the point of impact it may damage the retina and choroid before it rests at a new site. The vitreous usually becomes adherent to the wound and the gap is closed with fibrous tissue. The foreign body appears as a black or lustrous object, glinting with a metallic sheen, surrounded at first by white exudates and blood clot and eventually by a small encircling mass of white fibrous tissue around which pigments tend to accumulate. Occasionally the foreign body may rest upon the optic disc, at other times it buries itself in to the Optic nerve, where it is found only on enucleation or histological examination [6,7].

If the optic disk is struck and deeply wounded, a bizarre scotoma may be found, depending on the extent of the damage done to the nerve fibers. More usually degenerative changes occur in the retina with Pigmentary changes resembling that of Retinitis pigmentosa, and Pigmentary degeneration of the macula. Retina detachment is also common.

Specific effect of retained foreign bodies

Inorganic material, if allowed to remain on the eye, produces irritative effects by its interaction with ocular tissues. Glass and plastic provides good examples of tolerance of corneal tissues to inert material.

The reaction of the eye to a retained foreign body varies with the composition of particle. The ocular reaction may be of three types in the first place, inorganic substances cause no specific reaction except for mechanical irritation and an exudative and fibroblastic isolation of the foreign body. Secondly, a chemical reaction may produce a non-specific or occasional specific damage. In the third place, organic material tends to set up a proliferative response characterized by the formation of granulation tissue with the giant cells [6,8].

Metal foreign bodies which are detached by hammering travel with high velocity, and are usually sterile.

Inert substances [3-6,8]

The chemically indifferent substances are metals like gold, silver, platinum, lead , titanium, etc., or substances like stone, rock, sand, coal, clay and carbon, glass, quartz porcelain plastics; and organic material as rubber.

In the anterior chamber they elicit no irritation, but if introduced in the posterior segment, there is opacification, liquefaction and shrinkage of the vitreous gel. The infection is frequently introduced into the eye with a stone, when endophthalmitis occurs. If the lead lies in the retina or choroid, there is usually an exudation, partly fibrous and partly purulent, with a considerable amount of connective-tissue reaction.

Mercury

Mercury tends to excite an active purulent inflammation in the eye whether it lies in the anterior segment or the posterior segment; the

reaction is analogous to the necrosis which occurs in the cornea after mercury, its yellow oxide or calomel is injected into this tissue.

Copper

Copper as well as its alloys like brass and bronze, has frequently been found in the eye as a foreign body. If it is in a pure state the reaction is superlative in nature and catastrophic. In the anterior chamber this reaction becomes evident as an acute iridocyclitis with a hypopypon, in the posterior segment it leads to shrinkage of the vitreous detachment and degeneration of the retina, toxic papillitis and rapid phthisis. Only if the foreign body is embedded in the lens it is isolated as a cataract.

When the intra ocular foreign body is in the form of an alloy containing relatively little pure copper, a slow diffusion of copper, occurs occasionally with complete disappearance of the particle, so that the metal is deposited preferentially in the limiting membrane of the eye producing the picture of chalcosis.

1) A greenish blue ring in the peripheral cornea mainly located in the descemet's membrane;

2) A sunflower cataract in the anterior of the lens and exceptionally, a deposit on its posterior surface;

3) An impregnation of the zonular fibres;

4) The appearance of a multitude of a metallic particle in aqueous humour;

5) Occasionally a greenish coloration of the iris;

6) A brilliant and highly refractive deposit on the surface of the retina.

Iron

When a particle of iron is embedded in conjunctiva, sclera, cornea it undergoes partially disintegration and is deposited in the tissues in the neighborhood of the foreign body. There it appears as a particulate brown deposit resembling a "rust ring", which is evident in the epithelium, bowman's membrane and neighboring corneal stroma around the edges of the wound, particularly around the keratocytes.

Among all intraocular foreign bodies, those of iron and steel are the most important as seen in industrial accidents. Most foreign bodies which enter the eye arises from the mushroomed head of a chisel, a steel hammer, a high powered drill or form grinding tools at the emery wheel. The heat generated at the time of the detachment of the particle from the tool and maintained by the speed of its flight through the air, usually sterilizes the foreign body.

The delayed chemical effects of the iron upon the ocular tissues, the clinical picture of which was termed siderosis by Bunge, are much more harmful and set up a chronic degenerative process the normal termination of which is blindness.

Direct siderosis where iron is deposited in the immediate neighborhood of the foreign body, and indirect siderosis, where in the metal is diffused widely throughout the tissue of the eye producing the typical picture which usually ends in blindness form degeneration or detachment of retina or from glaucoma.

The extraction of foreign bodies containing iron is comparatively easy owing to their magnetizability. Less the ferrous content less the tendency for siderosis but greater the difficulty of the extraction owing to a diminution of magnetizability.

The electroretinogram shows characteristics changes in siderosis; the early response is of the negative-plus type which progress to negative –minus and eventually to extinction. The time of onset of retinal degeneration varies greatly from weeks to years.

Vegetable material

Wood produces a less severe reaction resulting at best in a scar which permanently affects vision and at worst in panophthalmitis and loss of eye. Vegetable matter foreign bodies are the commonest cause of infective corneal ulcers.

Vegetable matter is rarely met with as an intra-ocular foreign body. Occasionally the reactive iritis is considerable. Wood constitutes the commonest IOFB of vegetable nature (6% of all intraocular foreign bodies). The anterior chamber is the most common site of such a foreign body. Frequently the piece of wood is infected, in which case an acute pyogenic inflammation results as localized abscess, endophthalmitis or as fulminating panophthalmitis.

Two of the earliest report such a condition belongs to this category. The first was that of Victor (1847), where a thorn deeply embedded in the cornea, fell in to the anterior chamber during the effort to extract it; eight years later it was lying quietly in the same position. A proliferative response resulting in the massive information of fibrous tissue may appear clinically as pseudoglioma or a tumor.

Caterpillar hair produces ophthalmia nodosum, which is characterized by a severe granulomatous iridocyclitis with nodule formation.

Imaging of ocular foreign bodies [6-10]

In general, eyes with suspected IOFB require imaging to determine the presence, location and number of IOFBs. Non-contrast computerized tomography (CT) scanning has replaced conventional radiography as the diagnostic study of choice for all forms of ocular trauma. Computed tomography provides much more reliable information on size, shape, and localization of the foreign body, whether in the anterior or the posterior segment. Drawbacks of conventional CT include separate scanning in axial and coronal planes leading to prolonged scanning time and radiation exposure. Reconstruction is limited by stair-step artifact, compromising detection and localization of small and multiple foreign bodies, especially those adjacent to the sclera or optic nerve. Volume averaging also hinders detection and localization of small and multipleforeign bodies. Current spiral CT scanning with both 1-mm and 3 mm cuts can detect metallic IOFB as small as 0.5 mm with nearly 100% sensitivity [1,7]. Spiral CT allows continuous scanning in less time with volumetric, overlapping data acquisition, providing multiplanar reconstruction of high-quality coronal and sagittal images. Thinner slices mean less volume averaging and better detection and localization of small and multipleforeign bodies. Size and location of IOFB detected on helical CT corresponded with what was found during surgical and clinical follow-ups [8-10].

In eyes with small stable wounds, judicious use of B-scan ultrasonography over closed eyelids has proved useful in determining the extent of intraocular damage, retinal detachment, and double perforation, as well as in detectingforeign bodies not seen on CT, such as vegetative IOFBs. Using high-frequency (50 MHz) sound waves,

ultrasound biomicroscopy (UBM) is able to create high-resolution, 2 dimensional cross-sectional anterior segment images to a depth of 5 mm. It has proven to be a useful adjunct in the detection of small foreign bodies not, including those of nonmetallic composition, not otherwise detected by CT and/or B-scan ultrasonography. Magnetic resonance imaging are only occasionally useful in the setting of ocular trauma, such in the detection of radioopaque IOFBs in large unstable wounds and it must be avoided when iron-containing, i.e. metallic, IOFBs are suspected [6,7].

Management [3,5,7,8]

Removal of conjunctival foreign body: If in the conjunctiva, it is picked up by a needle after application of local anesthetic.

Foreign body spud: If in the cornea, it is gently scraped off with the foreign body spud with its blunt end

Sharp sterile needle: If the foreign body has penetrated in the superficial layers of the cornea, it is gently lifted by the sideways motion or by lever action of a sharp needle.

Removal of corneal foreign body

1) Make the eye anaesthetized with topical instillitation of 2 to 4% xylocaine and the patient is made to lie supine on an examination table. Lids are separated with eye speculum, the patient is asked to look straight upward and light is focused on the cornea. First of all, an attempt is made to remove the foreign body with the help of a wet cotton swab stick.

2) If it fails then foreign body spud or hypodermic needle is used.

3) After removal of foreign body, pad and bandage with antibiotic eye ointment is applied for 24 to 48 hours and antibiotic drop are instilled 3-4 times a day for about a week.

Treatment of intra ocular foreign body

It should always be removed, except when it is inert and probably sterile or when little damage has been done due to the vision and the process of removal may destroy sight.

Foreign body in the anterior chamber

It is removed through a corresponding corneal incision directed straight to the foreign body. It should be 3 mm internal to the limbus and in the quadrant of the corneal lying over the foreign body.

A) Magnetic foreign body is removed with a hand held magnet.

B) Non-magnetic foreign body is picked up forceps with toothless forceps.

Foreign body entangled in the iris tissue (magnetic as well as)

This is removed by performing sector iridectomy of the part containing foreign body.

Foreign body in the lens

An extra capsular cataract extraction with intra ocular lens implantation should be performed. The foreign body may be evacuated itself along with the lens matter or may be removed with the help of forceps.

Foreign body in the vitreous

Magnetic removal: This technique is used to remove a magnetic foreign body that can be well localized and removed safely with a powerful magnet, without causing much damage to the intraocular structures.

An intravitreal foreign body

It is preferably removed through pars plana sclerostomy (4mm from the limbus). At the site chosen for incision, conjunctiva is reflected and the incision is given in the sclera concentric to the limbus. A pre-placed suture is passed and lips of the wound are retracted. A nick is given in the under lying pars plana part of the ciliary body. And the foreign body is removed with the help of a powerful hand-held electro magnet. Pre-placed suture is tied to close the scleral wound. Conjunctiva is sutured with one or two interrupted sutures.

For an intra-retinal foreign body

The incision should be as close to the foreign body as possible. A trap-door scleral flap is created, the choroidal bed is treated with diathermy, choroid is incised and the foreign body is removed with either forceps or external magnet.

Forceps removal by pars plana vitrectomy

This technique is used to remove all non- magnetic foreign bodies and those magnetic foreign bodies that cannot be safely removed with a magnet. In this technique, the foreign body is removed with foreign body forceps after performing three-port pars plana vitrectomy under direct visualization using operating microscope.

Examples of common ocular foreign bodies management

Renuka et al. reported ten years old girl presented with a history of had hit in the right eye by a flower. Removal of foreign body was done on the operation theatre under peribulbar anesthesia. The eye were patched fine punctuate opacities were noticed the next day child was comfortable. These opacities disappeared in a week's time [10].

Srivastava et al. studied a young male with gross loss of vision and redness in right eye following injury days back. Visual acuity was Perception of Light+Projection of rays accurate in all quadrants. X-ray orbit anterio-posterior and lateral views showed a radio opaque foreign body at 6' o clock position. After the cornea became clear and hypopyon regressed to allow slit lamp examine lashes and foreign body was seen. The eye became quiet after three weeks. The eye lashes were removed by making an incision at 12' clock position under general anesthesia. A similar incision was to make to remove the metallic foreign body at 6' clock position. The corrected post-operative visual acuity was 6/9 [11].

Raju et al. reported a case of sixty-year old man was presented with a piece of wood, which had pierced below the right lower eyelid and was partially protruding out. On examination a piece of wood was seen piercing between the inferior orbital margin and globe of the right eye. Part of it was protruding out. Eyelids were normal. Extra ocular movements were tested and elevation and depression were found to be decreased. Slit lamp biomicroscopic examination revealed an apparently intact globe, normal conjunctiva and cornea, shallow anterior chamber, amid dilated pupil with efferent pupillary defect, a clear lens and a grossly normal fundus with mild media haze. Visual

acuity in the right eye was finger counting at 2 meters and the intra ocular pressure was found to be low. Left eye was normal. Direct and consensual pupillary reflexes were normal. Magnetic Resonances Imagine (MRI) showed the foreign body of length 7 cm to be passing between the right globe and inferior orbital margin, passing laterally, piercing the inferior orbital fissure and reaching the inferatemporal fossa. Emergency exploration and removal of the foreign body under general anesthesia was performed. After removing the foreign body on examining the globe the anterior chamber was shallow, the pupil was mid-dilated and the eye was very soft no breach of the sclera was found. The eye was padded with antibiotics. Patient was put on broad-spectrum antibiotics and anti-fungal drops [9].

Evaluation on the first post-operative day showed a stable general condition and normal extra ocular movements. Slit lamp biomicroscopy revealed a clear cornea, formed anterior chamber the patients' vision improved steadily from6/60 on first post-operative day to 6/9 at the end of first week [9].

Agarwal et al. reported an 8 years old boy with a swelling in left upper lid with purulent discharge. History of an injury two and half months duration sustain by a wooden piece. On examination tender swelling present on the medial side of left upper lid with purulent discharge. Skin was edematous and inflamed. No PL in the left eye, pupil was non-reacting, dilated and fixed, left eye was divergent, extra ocular movement is restricted; an axial proptosis of 3 mm was present. X-ray of skull and Computed Tomography (CT) scan show normal. Correlating the clinical history of a physical examination, a clinical diagnosis of foreign body granuloma was made, on exploration, under general anesthesia; a 7 cm wooden piece was removed. The sinus tract was scraped and cauterized tarsorrhaphy was done [1].

Conclusion

1. More stress should be on prevention and prophylactic measures need to be strictly enforced among industrial workers.

2. If the intra ocular foreign body proves to be iron or copper, it must be removed because of the risk of siderosis and chalcosis respectively.

3. Every intra ocular foreign body retained in the retina and choroid must be removed to prevent infection and further complications such as retinal detachment and scaring.

4. Any intra ocular foreign body known or suspected to be of inert material, showing no response around it, and which does not interfere with vision, can be followed closely and surgery can be deferred.

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