THE BRITISH JOURNAL

OF

OPHTHALMOLOGY

MARCH, 1945

COMMUNICATIONS

PENETRATING WAR WOUNDS OF THE EYE AND ORBIT*

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FROM Sicily into Italy and onwards during many months as the terrain and nature of the fighting changed so to some extent has the type of wound and the surgical problem involved, although fairly constant throughout.

Types of wound.—Military ophthalmic surgery is at present chiefly concerned with penetrating wounds due to high velocity fragment missiles resulting from high explosive action, the cause of 99 per cent. of battle casualties and accidents necessitating operation by the military ophthalmic surgeon. The other odd 1 per cent. of wounds are due to flying steel chips resulting from striking cold steel with a steel hammer, the commonest cause of intra-ocular foreign bodies in civil life. This type of injury is similar to a single high explosive fragment wound and presents an identical problem for investigation and treatment.

On the other hand war wounds of the eye and orbit due to high explosive action are often multiple, with additional wounds of the head, face, nose and ears, which suggests co-operative surgery by head, maxillo-facial, E.N.T. and ophthalmic surgeons.

* Received for publication, October 11, 1944.

It is the rule for wounds due to explosion of shells, mortar bombs and grenades to result from iron containing, *i.e.*, magnetisable fragments. But this should not be taken for granted because it is found that accompanying the iron fragments there are often other kinds of foreign body such as gravel or fragments of stone. The novice will soon be disillusioned who lightly presumes that because one wound is caused by a magnetisable fragment a near neighbouring wound contains a similar fragment.

Aluminium grenades have caused a percentage of serious eye wounds because the fragments being radio-translucent and non-magnetic are only sometimes removable even when they can be seen inside the eye. Alloys of aluminium as well as of other kinds of metal have also been found as penetrating fragments. These foreign bodies give a shadow in X-ray films but are non-magnetic and just as difficult to remove. Removal of such non-magnetic foreign bodies with forceps was successfully accomplished in comparatively few cases, but as the alternative is usually total loss of vision any reasonable attempt is justified.

Quite a variety of German mines have been encountered in successive stages of the campaign. At one time most of the mines were iron encased, whatever the nature otherwise of their contents, and magnetisable penetrating fragments were then the rule. At other times the H.E. agent was encased in wood or merely buried in the ground or amongst rocks, thus the resulting penetrating missiles, other than iron, included gravel, sand or dirt, wood, stone or lead fragments, etc., but fortunately never all together in the same mine.

Another less frequent type of wound was due to a rifle or machine-gun bullet "splash" of metal fragments from the nickel casing or its lead interior, accompanied by projected splinters of iron from a vehicle, glass from a windscreen or stone from a trench parapet; all of which have been seen.

Contusion of the globe is a frequent accompaniment of penetrating fragment wounds and adds to the difficulty of diagnosis and operative treatment. The contusion injury has to be differentiated from that due to the penetrating foreign body but it should never contraindicate operation for removal of a foreign body.

Blast contusion of the globe is commonly seen as a minimal clinical entity characterised by transient lowering of vision, general injection or redness of the eye, an intact cornea and lowering of ocular tension. Recovery is to normal in a few days. But all degrees of contusion injury are common and damage may include commotio retinae, laceration of intra-ocular tissues with intra-ocular haemorrhage, etc., culminating in extensive intra-ocular

disorganisation with loss of vision and perhaps also with multiple perforating wounds, or loss of the eye from rupture of the globe.

Routine examination and clean-up of Wounds.—Whenever possible vision should be recorded early. Examination of both eyes should be made with the pupils dilated. Penetrating wounds involving the face, eyelids, eyes and orbits require early investigation to determine the nature of the foreign bodies, their direction of travel and depth of penetration, as well as to assess the initial amount of damage and prevent loss of tissue by elimination of infection. While this investigation and clean-up of wounds is being done as many foreign bodies as possible should be removed. The earlier this is done after injury the better and easier it is. Routine trial with the magnet point is important, especially to wounds in and adjacent to the eyelids and conjunctival tissues, thus tiny iron fragments are often removed which would otherwise cause confusion with an intra-ocular foreign body in the radiograph. But on the other hand, diagnostic trial of a known intra-ocular foreign body with the giant magnet is to be deprecated. When negative it means nothing and when positive it means additional injury has been done to an already damaged eye. Any information thus gained never justifies this risk.

If for any reason operation has to be postponed, such as the more urgent need for evacuation, then the damaged eye should receive such treatment as will render the patient "fit to travel" for a period even up to 48 hours without the need arising for redressing the eye. Experience has shown that injured eyes travel very well if attention is given to certain treatment requirements, such as follows.

a. Meticulous clean-up of lids and adjacent skin surface, cutting of lashes, etc., and cleaning of conjunctival sac with saline or preferably proflavine 1/2000 sol.

b. Insertion of ca. penicillin-sulphathiazole powder mixture.

c. Ung. atropine 2 per cent. when necessary.

d. Covering with either vaseline gauze and large gauze-wool pad or the latter alone firmly secured by a long bandage, 4 in. cut in half.

Radiological examination.—Whether the wound is single or multiple the objective of this examination is fourfold.

a. To locate as precisely as possible any penetrating fragments, whether intra- or extra-ocular, orbital or etc.

b. To determine if possible their composition by noting the relative degree of radio-opacity.

c. To note any bony injury; fracture and displacements of bone.

d. To note any involvement of paranasal air sinuses or intracranial penetration, which will interest the E.N.T. or head surgeon.

Routine radiological examination should be made even if the foreign body can be seen within the eye, not only because one wishes to know its radio-opacity but because another unsuspected fragment may be present and also one gains valuable information from the examination of a radiograph when one already knows where the foreign body is situated in the eye. Precise localisation of an ocular or orbital foreign body being of such importance any extra trouble taken to attain this end is more than justified.

Equatorial ring method of X-ray localisation.—After long trial this method has proved its worth and is recommended as a routine.

It is necessary to have three sizes of ring which can be made, by R.E.M.E., from dental stainless steel wire, B.S.W. gauge 30, spot-welded to form rings of 24, 25 and 26 mms. internal diameter. At one spot on the ring the smallest possible bead of lead solder is applied. It will be found that a 25 mm. ring is that most generally used. Insertion of a ring into one or each eye is preferable just prior to radiological examination. A drop of cocaine solution is soothing but is unnecessary. The patient looks down, the ring is slid beneath the upper lid as far as it easily goes into the upper conjunctival fornix, the patient now looks up, and the lower edge of the ring is lifted with forceps over the lower lid margin and laid in the lower fornix. The ring is inserted so that the tiny lead bead on the ring lies in sight just above the caruncle. If the patient now looks fully towards each side in turn it can be readily seen if the ring is or is not a satisfactory equatorial fit.

If too small it rides forwards on the globe and looks too small, if too large it can be seen to lie away from the globe. If replacement is necessary to give a neat equatorial fit the 24 or 26 mm. ring can be used instead. No sutures are necessary, the ring remains in place and causes negligible discomfort or damage even to an injured eye.

Removal of the ring is by a procedure in reverse order to that of insertion. The patient looks up, the ring is lifted with forceps from the lower fornix over the margin of the lower lid, the patient now looks down, and the ring is lightly removed by sliding from beneath the upper lid.

Three routine radiographs are taken, or four if both eyes are involved. The film should be placed as near the injured eye as is possible and the X-rays should be directed through the eye rather than the orbit.

1. A direct lateral view of the head through the eyes with the eyes looking at right angles to the direction of the rays in the

same plane. The ring should appear in the film as a vertical line. This ideal is seldom attained, a narrow oval being the rule; the bead of solder on the ring identifies which is this nasal edge and indicates the direction of the rays. The position of the foreign body is noted relative to the ring which encircles the equator of the globe. If it is in the posterior wall of the globe this is usually judged accurately enough by experience without precise measurement.

2. An oblique lateral of one or each orbit with the respective eye turned laterally so as to be at right angles to the direction of the rays. It will be noted that the eye moves twice as much as the ring which only tilts or turns half way, and this must be allowed for when viewing the film. The ring shadow is again usually oval. This film is supplementary or rather confirmatory to the direct lateral view.

3. A direct postero-anterior view with the head tilted only just to throw the petrous shadow below the lower orbital margin, eyes looking in the same direction and plane as the rays are directed. It is not really necessary but each orbit can be filmed separately for greater accuracy. The ring appears as a circle and any ocular foreign body shadow must be inside it.

It is useful to compare the relative density of the foreign body shadow with that of the ring and its lead bead. It is an indicator of the nature of the foreign body; e.g., lead fragments resemble the denser shadow of the bead, iron may resemble the steel ring depending on the thickness of the foreign body, whereas stone and wood foreign bodies are definitely of lower radio-opacity.

Bakelite and aluminium are radio-translucent, whereas glass may give a shadow depending on its composition.

It may be objected that the ring is not strictly equatorial in all positions of the eye because it does not move equally with the eyeball, it only tilts half way in the direction the eye is turned. This is admitted but it does not alter the fact that operations planned on this radiographic evidence have been consistently satisfactory and confirm one's faith in the employment of the ring method.

As would be expected, extra-ocular and orbital foreign bodies are of more frequent occurrence than intra-ocular but this radiological method accurately localises either relative to the eyeball.

Operative treatment.—Without undue delay one should proceed to operation because there is urgency if not emergency.

Extra-ocular and orbital foreign bodies are removable from almost any location behind the globe if their size or position indicate that removal is preferable to leaving them where they are. Orbital depths may be reached by incision through the base of either lid keeping to one or other side of either the superior oblique

tendon or the inferior oblique muscle. To avoid injuring ocular muscle nerves exploration should proceed from outside the cone of muscles. Use of the magnet point may be a help in final identification of iron foreign bodies hidden in muscle or orbital fatty tissues.

Intra-ocular foreign bodies irrespective of their composition must first be localised within the globe. The metal fragment may be seen by the ophthalmoscope, and usually the earlier the eye is examined after injury the greater is this possibility; or its site may have to be judged by deduction from clinical and radiological evidence. Few ophthalmic surgeons have a giant magnet at their disposal, but most in this theatre of war have a small "hand" electro-magnet. Possession of a giant magnet permits either of two alternative operative methods, therefore the surgeon's choice of procedure may be limited by lack of it.

Removal per anterior route.—By the action of the giant magnet the foreign body is drawn forwards either through a previously damaged lens or around and between an intact lens and fully dilated iris into the anterior chamber from which it is then removed either through the corneal wound of entry or through a fresh keratome section of the cornea. To permit of this manoeuvre without damaging an intact lens or iris a well filled anterior chamber is essential, and the use of a hand electro-magnet advisable.

As a magnetisable foreign body always comes out obligingly with its long axis to the magnet point only very slight enlargement of the entry wound may be necessary.

Removal per posterior route.—This method is perhaps most often employed and is to be recommended because it permits:

- a. The use of the small electro-magnet.
- b. The nearest and most effective approach of the magnet point to the foreign body and, therefore, the shortest and most direct line for its removal.

The one objection is that this method requires making an incision through the retina unless extraction of the foreign body is accomplished through the scleral entry wound.

1. If the foreign body is judged to be more or less free inside the globe, *i.e.*, not firmly embedded in the scleral wall of the eye, it is advisable to make the posterior sclerotomy opening in the nearest radius by a stab incision of 3 mms. made with the point of a Graefe knife vertically inserted through the whole wall of the globe into the vitreous, inserting the knife point at approximately 7 to 8 mms. posterior to the limbus and cutting forwards 3 mms. towards it. This procedure has not, as might be thought, been followed by intra-ocular haemorrhage. The conical magnet point

is inserted about 2 mm. into the opening to withdraw the foreign body.

2. If the foreign body is seen or thought to be more or less firmly fixed in the posterior wall of the globe it is preferable to make a similar 3 mm. stab incision as near as possible to the foreign body and in a line parallel to but avoiding the larger retinal blood vessels likely to be damaged. Posterior stab sclerotomies of this type have been observed during the healing process up to eight weeks after operation and no sign of retinal detachment was then seen, but if a diathermy machine is available it is advisable to diathermy lightly the involved area of scleral surface before making the incision to minimise the possibility of retinal detachment.

The small electro-magnet used with success in this theatre of war is a composite gadget made from spare parts by R.E.M.E. at the request of the Adviser in Ophthalmology, Lt.-Col. B. W. Rycroft, A.F.H.Q., under the directive eye of Capt. Edward Livingstone, R.A.M.C.

It is small, the size of a 50 cigarette tin cylinder, composed of a solenoid coil of approximately 1 ohm resistance around a soft steel core, with a conical or alternative screw-on points, and combined end button switch.

The Livingstone-Mansfield intra-ocular hand electro-magnet. Initial model 1.

The Livingstone-Mansfield intra-ocular hand electro-magnet. Later model 2.

It is activated by a 12-volt battery giving 12 amperes current which creates a 4 lb. pull on the end of the magnet core.

No attempt is made to use statistics and the following quoted figures are merely interesting. During the last six months battle and accident casualties have been personally dealt with to the number of roughly 600 cases; of these approximately 300 were probable cases of intra-ocular foreign body and had radiological examination done resulting in 50 per cent. negative and 50 per cent. positive films. Of these latter 150 cases only 50 had successful operations for removal of the intra-ocular foreign body. Many eyes were lost for a variety of reasons, infection being negligible. Perhaps the commonest reason was that the particular eye was too badly damaged to survive without undue risk, another reason being that the foreign bodies were non-magnetic. Included were two cases of siderosis with loss of vision, each resulting from several months retention of an iron foreign body, removed in either case. There was no evidence of sympathetic ophthalmia in either of these cases, nor has it been seen in any others.

In conclusion, the purpose of this paper is:

1. To recommend the equatorial ring method for radiological investigation and localisation of all orbital and ocular foreign bodies.
2. To plead for the more confident use of the smaller "hand" electro-magnet which, if properly designed, may with advantage replace the giant magnet.
3. To convey some impressions resulting from recent activity in a busy centre of ophthalmic war surgery.

HYSTERIA IN OPHTHALMOLOGY*

Experiences with New Zealand Troops in the Middle East

BY

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THE writer was ophthalmologist at the New Zealand Hospital at Helwan, Egypt, for three years from the end of March, 1941. This hospital served New Zealand Base and to it were referred the great majority of New Zealand ophthalmic sick or wounded as direct admissions, as transfers for treatment or disposal, or as out-patients for investigation.

It may reasonably be assumed that, with the exception of any

* Received for publication, September 6, 1944.