EYE BURNS CAUSED BY TEAR GAS*†‡

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LACRIMATORS are compounds which, in gaseous form in extremely small concentrations, act as conjunctival irritants. Chemically, almost all are halogenized organic substances. Because of a loose mesomer connexion the halogen atom is very reactive.

Duke-Elder (1954) listed more than ten liquid or solid tear producers. *Chloracetophenon* (Fig. 1) has been that most frequently used for many years, and is at present the cause of practically all tear-gas injuries.

FIG. 1.—Chloracetophenon. Chemical formula.

Lacrimators were employed during the first world war, and in some countries the police still use tear-gas bombs and projectors to break up unruly demonstrations. The development of tear-gas weapons as a means of self-defence began in the late 1920s. Present-day weapons take the form of a pistol or drum revolver, and can nearly all fire several rounds without reloading. The bore is smaller than the normal calibre for conventional ammunition. The cartridge is filled with chloracetophenon above the explosive, and the case is sealed with a cork or a layer of wax. Besides pistols, there are spray flasks, the smallest being only the size of a fountain pen.

In some countries tear-gas weapons are forbidden. There are no uniform laws in this matter in West Germany as each state has its own ruling. In general, however, it is easy to obtain a weapon and the necessary cartridges, and eye injuries caused by tear irritant substances have therefore become a problem for the ophthalmologist in recent years.

Nearly all serious tear gas eye burns are caused by shots fired at close range so that not only the lacrimator but also the charge and seal penetrate the tissues. At long range the tear irritant usually reaches the eye in gaseous form, and such shots are *not* dangerous to sight as the hyperaemia of the conjunctiva and the epiphora disappear quickly when the irritation subsides.

In the last 12 years we have been able to observe almost fifty cases of injuries resulting from near shots.

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Symptoms and Clinical Course

Shortly after the trauma, the lids are swollen and oedematous. There are multiple powder infiltrations and smoke deposits on the skin of the face. Powder particles on the ridge and base of the nose indicate a bilateral burn. Unilateral burns show a ring of smoke deposit shaped like a monocle.

The majority of cases show ischaemia and chemosis of the conjunctiva. Massive powder infiltration of the conjunctiva, cornea, and sclera with holes in the conjunctiva (Fig. 2) or globe result from near shots.

FIG. 2.—Powder infiltration of the conjunctiva, cornea, and sclera, with a tear in the nasal conjunctiva.

The corneal parenchyma is at first clear for the most part and there may be no more than an epithelial oedema or superficial erosion (Fig. 3a). After an interval of hours or days, however, there follows a slow clouding of the corneal stroma (Fig. 3b) due to damage to the marginal conjunctival plexus. These trophic disturbances are extremely difficult to cure. Later, a considerable deep vascularization appears (Fig. 3c) and the epithelial defects heal only slowly. With time, the vascularization may be reduced by careful local treatment with corticosteroids (Fig. 3d).

Complications.—Symblepharon and pseudopterygium, infective corneal infiltration or ulcers, trophic corneal disturbances, posterior synechiae, secondary glaucoma, cataracts, hyphaema, vitreous haemorrhage, and damage to the optic nerve due to contusion may occur.

Loss of Vision.—The visual acuity achieved after treatment may vary from almost perfect vision to perception of light, depending on the distance of the shot (2 m.–10 cm.) and the amount of infiltrated substance. The reduction of visual function is greater in unilateral cases because of the closer range and greater concentration of the lacrimator.

In cases treated at our clinic the scale of unilateral or bilateral lesions ranged from dense leucoma to slight superficial corneal opacity.

Treatment

The first step is the removal of foreign bodies, followed if necessary by scraping the corneal epithelium, and a radial incision of the conjunctiva (Passow, 1939, 1955). This is followed by the subconjunctival injection of vasodilators, and the local application of vasodilating and acetylcholine ointments with an antibiotic base. Warm fomentations are also useful. Artificial mydriasis is recommended so long as there is no suspicion of secondary glaucoma. With increased vascularization and epithelialization, the vasodilators and acetylcholine should gradually be reduced.

Local treatment with corticosteroids may then follow, and if necessary a corneal graft may be attempted.

(a) Pericorneal ischaemia, chemosis of conjunctiva, and epithelial oedema of cornea, shortly after trauma.

(b) 12 days later. Corneal erosion and trophic disturbances of the stroma.

(c) Beginning of deep vascularization. Epithelium still defective.

(d) Reduction in vascularization, complete healing of corneal epithelium, clouding of stroma.

FIG. 3.—Clinical course of a tear-gas burn.

Conclusions

A study of the literature (Hoffmann, 1965; Oaks, Dorman, and Petty, 1960; Uhde, 1948) and an evaluation of our own cases led to the conclusion that close shots from a tear gas weapon always present a grave danger to the eye.

The damage is mainly of a chemical nature, though shots from extremely close range may produce contusion. The thermal component can be ignored.

Little is known about tissue changes due to the infiltration of the tear irritant substances. It is possible that hydrochloric acid may be set free after contact with protein so that coagulation necrosis results. Therapy is therefore symptomatic.

Whalman (1943) recommends a mixture of 0.4 per cent. sodium sulphite, 75 parts glycerine, and 25 parts water as a specific neutralizer of tear gas. However, according to Grant (1962), this treatment has had no convincing success.

Press reports concerning penalties imposed upon foreign tourists who have taken gas pistols to England lead to the assumption that the private possession of tear-gas weapons in Great Britain is illegal. They should in fact be universally forbidden because of the risk to sight. Dangerous close-range shots are fired mainly by antisocial, imprudent, and careless persons.

Summary

A short description is given of the experience gained in treating almost fifty cases of ocular injuries caused by tear-gas weapons. The clinical course of these burns is characteristic. Treatment remains symptomatic until more is known about the chemical changes occurring in the tissues of the infiltrated substances. Tear-gas weapons should be forbidden because of their danger to sight.

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