



Section of Ophthalmology

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Registrars' Papers and Cases

Changes in the Permeability of the Corneal Endothelium in Herpes Simplex Stromal Keratitis

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Infection of the corneal epithelium with the herpes simplex virus may lead to stromal keratitis. In this paper experiments are described in which changes in the permeability of the corneal endothelium were measured, and suggestions are made regarding the mechanism by which the pathological state of disciform keratitis may occur.

The patients were selected from the Virus Clinic at Moorfields Eye Hospital, London, and all had recently suffered from virus infection of the corneal epithelium of one eye, with subsequent development of central disciform keratitis. All the patients had reached a stage when the epithelium had healed and there was minimal stromal activity. In general the cornea showed slight central swelling and some cellular infiltration in the more superficial and in the deeper layers of the stroma; in each patient the contralateral eye was unaffected and provided a control.

Treatment

Oxybuprocaine drops were instilled into the conjunctival sac, followed by the introduction of fluorescein into the cornea by electrophoresis. The negative electrode of the iontophoresis unit consisted of an agar-gel rod containing 10% fluorescein; the positive electrode was a metal plate held in the patient's hand. The agar-gel rod was held against the central cornea for sixty seconds while a current of 2 μ A was passed through the circuit; this produced dense fluores-

cein staining of the central cornea. Over a period of several hours the dye permeated throughout the stroma and through the endothelium into the anterior chamber whence it was lost by bulk flow from the angle and by diffusion into the iris. After several hours a steady state was reached when the rate at which fluorescein was lost from the cornea became equal to the rate at which it was lost from the anterior chamber. Thus, the falling concentration-time curves for cornea and aqueous became parallel when plotted on semi-logarithmic paper (Fig 1). From this graph it is possible to calculate the transfer coefficient (k_{ca}) from the cornea to the aqueous. Determinations of fluorescein concentration were made with the objective fluorophotometer (Maurice 1963) approximately eighteen hours after the introduction of the dye. With this instrument it was

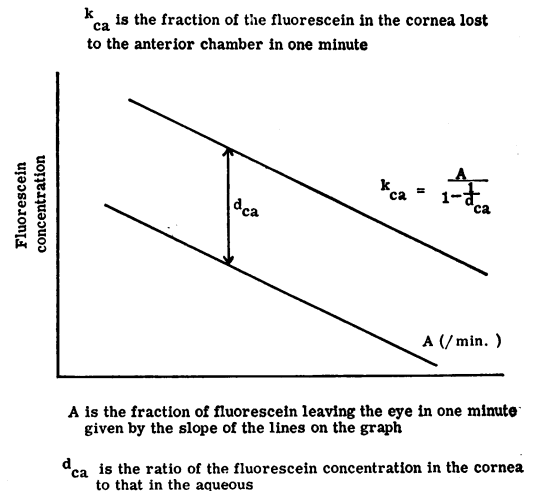


Fig 1

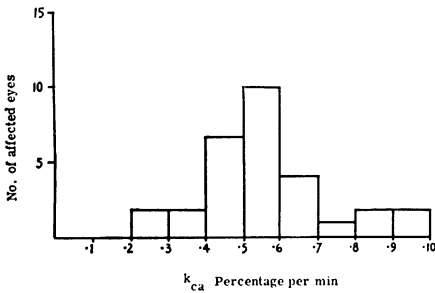


Fig 2 Transfer coefficient from cornea to aqueous in 33 normal eyes

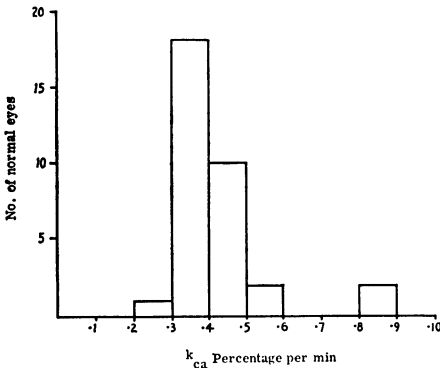


Fig 3 Transfer coefficient from cornea to aqueous in 33 eyes affected by disciform keratitis

possible to measure the fluorescence of the deeper layers of the stroma and of the anterior aqueous humour in a series of readings taken over the course of two or three hours.

Results

The findings are shown in the histograms (Figs 2 & 3). In the majority of normal eyes the value of k_{ca} is close to 0.4%, but in most of the affected eyes the value was considerably higher. On average the transfer coefficient in the affected eyes was increased by 40% over that in the control eye of the same patient. Some eyes were receiving treatment, either with idoxuridine, or with idoxuridine and local steroids, but it was not possible to detect any significant difference in the results which might be attributed to the treatment. Owing to swelling of the stroma in an affected eye it contains more fluorescein, for a given fluorescein concentration, than the normal fellow control eye; therefore for a given value of k_{ca} a greater total amount of the dye would have passed through the endothelium in a given time. That is, the permeability of the affected cornea would have been still more increased than the increment in the transfer coefficient had suggested.

A number of possibilities could account for this finding of increased endothelial permeability in stromal keratitis: (1) The endothelium may have been affected by the virus, or by products of the virus, or by an antigen-antibody reaction, or by another reaction of the cornea to the infection or to the treatment. (2) The increase in permeability may be due to an effect on the endothelial cells, or on the intercellular pores or on Descemet's membrane. (3) The augmented permeability may allow fluid from the anterior chamber to enter the stroma in excess, resulting in corneal oedema causing separation of the lamellæ which in turn might allow the characteristic cellular infiltration. (4) The microstructure of the cornea may permit accumulation of fluid in the deepest and the most superficial layers of the stroma, for this is where cellular infiltration is most frequently seen. In fact, one may ask whether increased permeability of the corneal endothelium is responsible for the whole morphological picture of disciform keratitis.

Acknowledgments: I am indebted to Professor Barrie Jones for allowing his patients to take part in these experiments and to Dr D M Maurice for his assistance with the calculations.

REFERENCE

Maurice D M (1963) *Exp. Eye Res.* 2, 33

Studies on Relatives of Glaucoma Patients

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In this survey 201 relatives of known glaucoma patients were examined.

Methods

Subjects were contacted through glaucoma patients who had attended the Institute of Ophthalmology. On the first visit the fundi, especially the discs, were examined, a slit-lamp examination was made, Goldmann applanation tensions were recorded and gonioscopy was carried out. If suspicious discs, tension over 20 mm in one or both eyes, or angles suspected of predisposing to angle closure were found the patient was regarded as a glaucoma suspect and at a second visit refraction, central fields, tonography as well as phasings, darkroom and mydriatic tests were carried out as indicated. These subjects are being followed up at six-monthly or yearly intervals.