CORNEAL THERMAL PATTERNS IN ANTERIOR UVEITIS*†

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SURFACE temperature changes in the eye have been described in various ocular diseases (Zeiss, 1930; Huber, 1960; Gros, Bronner, and Vrousos, 1967) using either a contact or a radiometric method of measurement. This paper describes the corneal and periorbital skin temperature variations that occur in unilateral anterior uveitis, and the pattern of change during and subsequent to the inflammation.

Material and Methods

Surface temperature was measured with a bolometer; the method of use and precautions to be taken are described in a previous paper (Mapstone, 1968a).

A series of 53 unselected patients with unilateral acute anterior uveitis was investigated, temperatures being measured over four areas on each side of the median plane: cornea, medial forehead skin, lateral forehead skin, lower lid skin. From these measurements the temperature differences between the side of the inflamed and normal eye were calculated (Δt) and the result plotted against time. Each patient was treated initially with gutt. Predsol 0.5 per cent. 2-hrly and gutt. Atropine 2 per cent. twice daily; if there was no clinical response a subconjunctival injection of Depomedrone 8 mg. was given.

Results

The corneal thermal patterns were divided into three groups depending on whether Δt was positive or negative:

- (1) Δt positive
- (2) Δt negative
- (3) Δt initially at least $+0.5^{\circ}\text{C}$. but subsequently at least -0.5°C . although signs of inflammation were still present.

Group 1 (44 patients).—The Table records the salient data from this group, which was divided into four subgroups according to the magnitude of the maximum Δt recorded during the inflammation.

TABLE
DATA FROM PATIENTS IN GROUP 1

Group	1a	1b	1c	1d
Number of Patients	13	9	10	12
Maximum Corneal Δt ($^{\circ}\text{C}$.)	0.1–0.5	0.6–1.0	1.1–1.5	> 1.5
Mean Duration of Ciliary Injection (days)*	12	19	22	40
Systemic Disease:				
Ankylosing spondylitis	—	1	3	6
Reiter's disease	—	—	—	1
Subphrenic abscess†	—	—	1	—
Sex Ratio M : F	9 : 4	5 : 4	5 : 5	10 : 2

* Mean of time interval between first attendance at hospital and record of no ciliary injection.

† This patient developed a metastatic abscess in the eye.

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Fig. 1 shows a graph of corneal Δt plotted against time in a representative patient from each subgroup. The severe inflammation in Group 1d and to a lesser extent in 1c, is associated with a periorbital skin Δt of up to $+2.5^{\circ}\text{C}$. Seven of the twelve patients in 1d had a biphasic corneal Δt pattern and three of these are illustrated in Fig. 2, opposite.

FIG. 1.—Corneal thermal patterns of patients in Group 1
EI = Eye injected.

If the maximum corneal Δt recorded in each of the 44 patients is plotted against duration of ciliary injection, then the equation of the regression line is $t = 0.03d + 0.37$ (Fig. 3, opposite). The correlation coefficient of t and d is $+0.68$, and erection of a null hypothesis that there is no correlation leads to its rejection ($t = 6.01$; $P < 0.001$).

FIG. 4.—Thermal pattern of patients in Group 2.
EI = Eye injected.

Group 2 (5 patients).—This presents the paradox of a red eye with a corneal temperature less than that of the opposite normal eye (Fig. 4, opposite).

Group 3 (4 patients).—The graphs of corneal and medial forehead skin Δt from one of these is shown in Fig. 5.

FIG. 2.—Biphasic thermal patterns of patients in Group 1d.

FIG. 3.—Plot of corneal Δt maximum against duration of ciliary injection.

FIG. 5.—Thermal pattern of patient in Group 3.
EI = Eye injected.

Discussion

In normal subjects mean Δt for cornea or periorbital skin is either positive, negative, or zero, these patterns, indicating that one side has a blood supply which is constantly greater than, less than, or equal to the opposite side (Mapstone, 1968b, c).

The patients in Group 1 all show to a varying degree an increase in corneal temperature and Fig. 1 represents a progression from mild to severe inflammations. The greater the relative increase in corneal temperature the longer the duration of ciliary injection, a highly significant positive linear correlation existing between these two variables. Accepting the premise that clinical duration and corneal Δt maximum are two aspects of the same problem,

viz. intensity of disease, then variations in corneal Δt offer a parameter whereby the behaviour of anterior uveitis can be objectively assessed.

In clinically severe inflammations, the inflammatory vaso-dilatation spills over onto periorbital skin, and in addition the corneal Δt pattern tends to be biphasic, each peak being associated with an exacerbation of signs and symptoms. The second peak can be explained either as an escape from the effect of a subconjunctival repository steroid given at the onset of the inflammation, or—if the inflammation is due to a discrete isolated insult—to two exposures to the latter.

The inflammations in Group 1a and to a lesser extent 1b are transient, contrasting with those in 1c and 1d. Of the 22 patients in the latter two subgroups eleven could be assigned to a relationship with a systemic disease, whereas of the 22 in the former two subgroups only one could be so assigned. The inference is well known, *i.e.* the uveitis associated with ankylosing spondylitis is severe, but greater interest must attach to the fact that mild inflammations have no such systemic associations and apparently arise spontaneously.

The patients in Group 2 have a negative corneal Δt in spite of an anterior uveitis. This can occur in two circumstances, either as a result of local destruction of the vessels of the anterior segment or from ipsilateral carotid artery stenosis (Mapstone, 1968b). The two can be differentiated since in carotid stenosis ipsilateral medial forehead skin Δt will be abnormally negative (Wood, 1965), whereas with pathology restricted to the anterior segment it will be unaffected. In Fig. 4a, corneal Δt became $+0.1^{\circ}\text{C}$. at the height of the inflammation but was subsequently abnormally negative. This patient has had previous uveitis in both eyes, but in the eye affected on this occasion there had been an episode of secondary glaucoma in the past, the interpretation being that this is an ischaemic anterior segment due to previous disease. The patient illustrated in Fig. 4b also has a negative corneal Δt but in addition the medial forehead skin Δt is abnormally negative, *i.e.* the surface territory of supply of the internal carotid is ischaemic. The interpretation is that anterior uveitis developed in an eye rendered ischaemic by carotid artery stenosis. Three patients showed this pattern.

The four patients in Group 3 have characteristics of both the preceding groups, and in the patient illustrated in Fig. 5 there is a rise in ipsilateral corneal temperature followed by the assumption of an abnormal negative value. This change was associated with the disappearance of all ciliary injection but a heavy flare and circulating cells persisted; in addition medial forehead skin Δt became abnormally negative. Again there is ischaemia in the territory of supply of the internal carotid artery but here the most probable explanation would be that the uveitis was of sufficient severity to produce an inflammatory occlusion of the vessels of the anterior segment (the eye is now phthisical with a constant heavy flare and applanation tension of 8 mm. Hg) and also to involve the supra-orbital and frontal branches of the ophthalmic artery in the orbit—hence the negative medial forehead Δt .

Summary

Acute unilateral anterior uveitis produces an increase in temperature in cornea and periorbital skin relative to the opposite normal side.

A highly significant positive linear correlation exists between the maximum corneal temperature increase recorded during an acute inflammation and the duration of ciliary injection.

50 per cent. of patients with a maximum relative corneal temperature increase of greater than 1°C. could be assigned to a relationship with a systemic disease. Uveitis with a temperature increase less than this has no such relationship.

Five patients had an ischaemic anterior segment and three had the thermal pattern shown by individuals with internal carotid artery stenosis.

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