CLINICAL ELECTRO-OCULOGRAPHY

The eye generates an electric potential of about 6 millivolts, with the cornea positive to the fundus, this being known as the standing or corneo-fundal potential. It is possible to measure this directly, but clinically it is more convenient to measure it indirectly by attaching electrodes to the skin at either side of the eye and moving the eye from side to side between them. As the cornea approaches one electrode a positive charge is induced in it relative to the other, and this potential difference may be amplified. If this amplified signal is recorded on moving paper a "saw-tooth" trace is produced, the vertical sections representing eye movements, and their lengths depending on the amplitude of the eye movement and the level of the standing potential (Fig. 1).

FIG. 1.

This technique may be used to detect and record eye movements, and is known as *electro-nystagmography*. If the eye movements are of constant amplitude, then any change in the height of the record indicates a change in the standing potential, and this is the basis of *electro-oculography*.

The standing potential fluctuates, and great changes may be induced by changes in illumination. A decrease of illumination gives a fall in potential to a *dark trough* level, and subsequent illumination gives a rapid rise to a *light peak* level. The degree of rise in this sequence depends on the time in the dark and the intensity of the re-illuminating light. It is this sequence of dark and light that is used in the clinical test.

Clinical Procedure

The eyes are tested separately and recorded on separate channels. The subject is rehearsed in moving his eyes between two fixation lights subtending 30°, the usual rate being one or two a second. When movements are regular the room lights are turned out, and recordings are taken for 5 to 10 seconds every minute. After 12 minutes in the dark the eyes are re-illuminated by a battery of fluorescent tubes, and recordings are continued every minute until a peak level is passed or is obviously not going to appear. The light peak is generally achieved by 10 minutes, giving a test time of less than half an hour. The average height of each minute's record is calculated, and the light-induced

change in the standing potential is expressed as a ratio: $\frac{\text{highest level in the light}}{\text{lowest level in the dark}} \times 100$. (Fig. 2).

A ratio of under 185 per cent. should be considered abnormal.

The useful data from the test are:

- (1) The light peak/dark trough ratio.
- (2) The similarity of the ratios of the two eyes, which are normally very close.
- (3) The time taken to reach the light peak.

Physiological Basis

The light-induced change in the standing potential is associated with the visual purple cycle. The requirements for a change to occur in a normal E.O.G. are as follows:

- (1) Normal receptors. (2) Normal pigment epithelium. (3) Contact between receptors and pigment epithelium. (4) Adequate choroidal blood supply.

The E.O.G. is thus an objective test of the viability of the outer layers of the retina. It measures the activity of the retina as a whole, and so small lesions will remain undetected.

Uses of the E.O.G.

As light may reach the retina despite the presence of opacities in the media, it is possible to elicit an E.O.G. when such opacities prevent a view of the fundus.

In many retinal conditions, particularly the tapeto-retinal degenerations, functional abnormalities precede fundus changes, and the E.O.G. is abnormally low when all other tests (e.g., visual fields, dark adaptation) are normal. In the later stages of these conditions the E.O.G. will help to distinguish them from post-inflammatory changes.

In unilateral eye diseases, comparison of the E.O.G.s of the two eyes will give some indication of the extent of the damage and the likelihood of recovery (e.g., central retinal vein occlusion). Unilateral depression of the E.O.G. with no ocular sign would suggest incipient eye disease, or a deficient blood supply to that eye.

The test is also useful in the investigation of poor vision or deficient night vision with no obvious cause. Combined with electro-retinography and other psychosensory investigations it is a useful research tool as well as a method of clinical investigation.

Difficulties with the Test

(1) Ocular movements. If these are not regular it may be impossible to estimate the change in potential.

(2) Variability of the ratio. This varies greatly from person to person, and also in the same person from time to time. Variations in the E.O.G. cannot be taken to indicate changes in retinal function in any individual.

The E.O.G. is altered in too many conditions to allow it to be a diagnostic test, but it is a useful ancillary aid in the investigation of many diseases. The information that may be derived from it depends upon an understanding of its principles, and its use in conjunction with other clinical investigations.

General Reference:

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Illustrations:

JOHN H. KELSEY

JOHN H. KELSEY,
 ELECTRODIAGNOSTIC CLINIC,
 MOORFIELDS EYE HOSPITAL,
 LONDON, W.C.1.