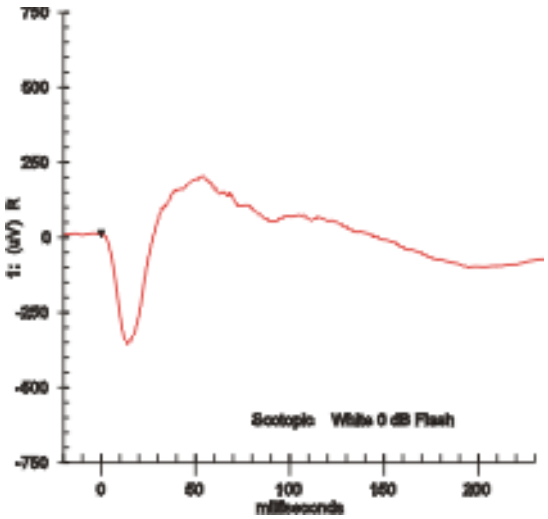
Electroretinography

Electroretinography measures the electrical responses of various cell types in the retina, including the photoreceptors (rods and cones), inner retinal cells (bipolar and amacrine cells), and the ganglion cells. Electrodes are usually placed on the cornea and the skin near the eye, although it is possible to record the ERG from skin electrodes. During a recording, the patient's eyes are exposed to standardized stimuli and the resulting signal is displayed showing the time course of the signal's amplitude (voltage). Signals are very small, and typically are measured in microvolts or nanovolts. The ERG is composed of electrical potentials contributed by different cell types within the retina, and the stimulus conditions (flash or pattern stimulus, whether a background light is present, and the colors of the stimulus and background) can elicit stronger response from certain components.



Maximal response ERG waveform from a dark adapted eye.


A patient undergoing an electroretinogram

If a flash ERG is performed on a dark-adapted eye, the response is primarily from the rod system and flash ERGs performed on a light adapted eye will reflect the activity of the cone system. To sufficiently bright flashes, the ERG will contain an a-wave (initial negative deflection) followed by a b-wave (positive deflection). The leading edge of the a-wave is produced by the photoreceptors, while the remainder of the wave is produced by a mixture of cells including photoreceptors, bipolar, amacrine, and Muller cells or Muller glia.[1] The pattern ERG, evoked by an alternating checkerboard stimulus, primarily reflects activity of retinal ganglion cells.

Clinically used mainly by ophthalmologists and optometrists, the **electroretinogram (ERG)** is used for the diagnosis of various retinal diseases[2] . Inherited retinal degenerations in which the ERG can be useful include:

- Retinitis pigmentosa and related hereditary degenerations
- Retinitis punctata albescens
- Leber's congenital amaurosis
- Choroideremia

- Gyrate atrophy of the retina and choroid
- Goldman-Favre syndrome
- Congenital stationary night blindness - *normal a-wave indicates normal photoreceptors; absent b-wave indicates abnormality in the bipolar cell region.*
- X-linked juvenile retinoschisis
- Achromatopsia
- Cone dystrophy
- Disorders mimicking retinitis pigmentosa
- Usher Syndrome

Other ocular disorders in which the standard ERG provides useful information include:

- Diabetic retinopathy
- Other ischemic retinopathies including central retinal vein occlusion (CRVO), branch vein occlusion (BVO), and sickle cell retinopathy
- Toxic retinopathies, including those caused by Plaquenil and Vigabatrin. The ERG is also used to monitor retinal toxicity in many drug trials.
- Autoimmune retinopathies such as Cancer Associated Retinopathy (CAR), Melanoma Associated Retinopathy (MAR), and Acute Zonal Occult Outer Retinopathy (AZOOR)
- Retinal detachment
- Assessment of retinal function after trauma, especially in vitreous hemorrhage and other conditions where the fundus cannot be visualized.

The ERG is also used extensively in eye research, as it provides information about the function of the retina that is not otherwise available. Other ERG tests, such as the Photopic Negative Response (PhNR) and pattern ERG (PERG) may be useful in assessing retinal ganglion cell function in diseases like glaucoma.

The **multifocal ERG** is used to record separate responses for different retinal locations.

The international body concerned with the clinical use and standardization of the ERG, EOG, and VEP is the International Society for the Clinical Electrophysiology of Vision [3]

See also

- Electrooculography
- Visual evoked potential

References

[1] Webvision at University of Utah (http://webvision.med.utah.edu/ERG.html#The origin of the major ERG waves)
[2] Electroretinography (http://www.nlm.nih.gov/medlineplus/ency/article/003388.htm), U.S. National Library of Medicine, 11 april 2005 (accessed 19 January 2007)
[3] ISCEV Website (http://iscev.org)

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