
UNIT 17 ELECTRO-PHYSIOLOGY OF THE EYE

Structure

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- 17.2 Electro-retinogram
- 17.3 Visual Evoked Response
- 17.4 Electro-oculogram
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17.0 OBJECTIVES

After completing this unit, you should be able to understand the purpose of an:

- electro-retinogram;
- visual evoked response; and
- electro-oculogram.

17.1 INTRODUCTION

Electric activity in retina and visual pathway is the inherent property of the nervous tissue. Visual stimuli is converted into electric signal at the level of nervous tissue. This electric activity can be measured by putting electrodes close to the site of impulse generation, e.g., at cornea with the help of contact lenses to **know** the impulses on retina or at back of head to know impulses generated from occipital cortex.

17.2 ELECTRO-RETINOGRAM

Electro-retinogram (ERG) is the record of the change of the resting potential produced by the retina when light is thrown on it. The recording of changes in the resting potential of the eye is induced by a flash of light. This change is brought about by a composite of electrical activity of photoreceptors, Muller cells and retinal pigment epitheliuin (RPE).

Normal ERG

The components of normal ERG are:

- 1) **a-wave:** Initial corneo-negative wave.
 - Arises due to hyperpolarisation of photoreceptors.
- 2) **b-wave:** A large corneo-positive wave.
 - Shows the activity of Muller cells (bipolar cells).
- 3) **c-wave:** A prolonged positive wave.
 - Shows the activity of retinal pigment epithelium.

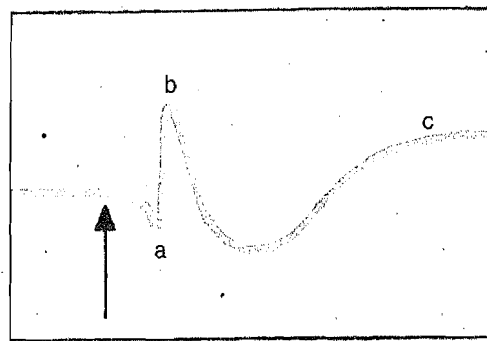


Fig. 17.1: Components of electro-retinogram

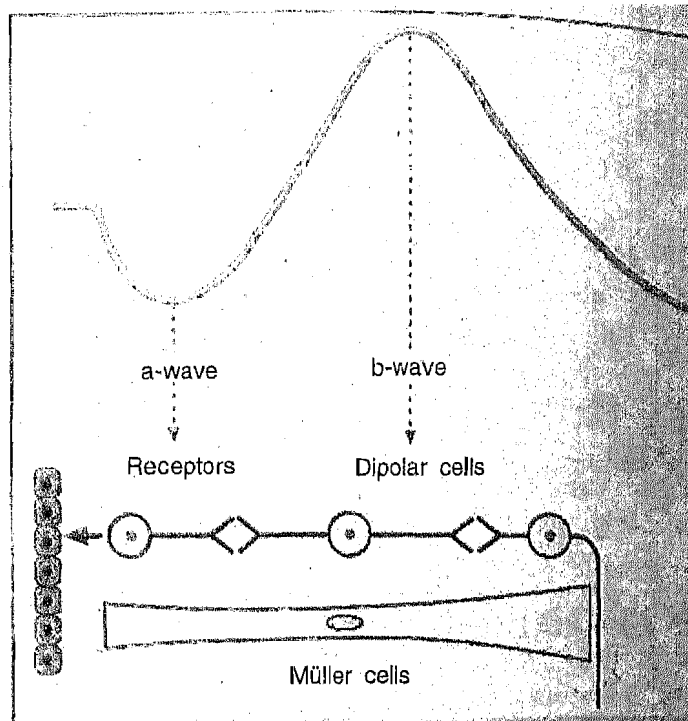


Fig. 17.2: Components and origin of the electro-retinogram

An ERG recording is taken as follows:

- 1) All active electrode is placed on the cornea (embedded in a contact lens).
- 2) A reference electrode is placed on the patient's forehead.
- 3) A ground electrode is placed on the ear lobe as a stimulus.
- 4) A diffuse light is thrown on the dilated pupil.
- 5) The elicited response is recorded.

Forms of ERG:

- Bright flash: for severely traumatized eye.
- Focal ERG: ERG at small area of 10 degree.
- Multifocal ERG: Many Focal area combined together by computer to give a generalized picture.
- Pattern ERG: Alternating check board pattern are shown and ERG noted.

ERG is useful to study:

- Retinal Functions
- Retinal Degeneration

- Retinal Disease:
 - Retinitis Pigmentosa
 - Retinal Detachment
 - Leber's Amourosis
 - Tay Sach's disease
 - Diabetes
 - .Open Angle Glaucoma
 - Toxic Retinopathies
 - Vascular occlusions of retina

Check Your Progress 1

Give functions, forms and uses of ERG

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17.3 VISUAL EVOKED RESPONSE

VER refers to electro-encephalographic recording made from the occipital lobe in response to visual stimuli. It has two positive waves p1 and p2 and two negative waves v1 and v2.

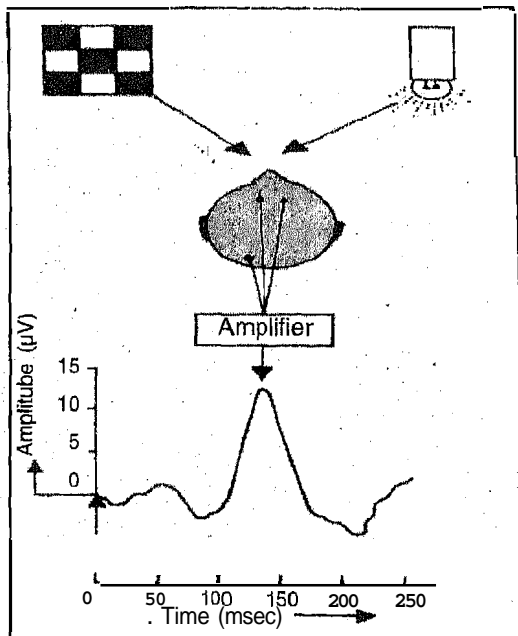


Fig.17.3: Visual-evoked response

Two patterns of stimuli are shown:

- 1) Flash: Normal Amplitude > 5 mv, latency < 100 ms.
- 2) Pattern stimulus: Normal Amplitude > 7.5, latency < 110 ms.

Uses: VEP is useful for diagnosis of:

- Optic Nerve disease
- Visual pathway defects
- Multiple Sclerosis
- Intracranial Surgical Procedures
- Optic Neuritis
- Amblyopia
- Hysteria
- Glaucoma

Check Your Progress 2

Describe the wave pattern of VEP.

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17.4 ELECTRO-OCULOGRAM

This is based on the measurement of resting potential of the eye which exists between the cornea (+) and back of retina (-) during fully dark adapted and fully light adapted condition. In it electrodes are placed near the orbital margins near the medial and lateral canthi. A forehead electrode serves as a ground electrode. The patient sits straight with a central light and two side lights serving as a right and left fixation light.

Graph shows (Fig. 17.4) light response and dark response in light and dark adapted states respectively.

$$\text{Arden Ratio} = \frac{\text{Light Peak} \times 100}{\text{Dark Trough}}$$

Values:

Normal > 185

Subnormal 165-185

Abnormal < 165

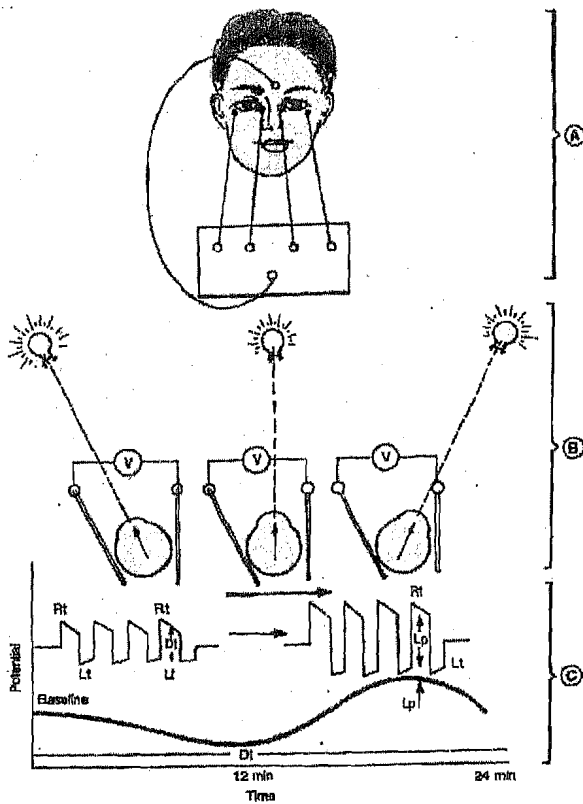


Fig. 17.4: Electro-oculogram

Use: EOG is abnormal in severe form of diseases as described in ERG. There are two conditions in which ERG is normal whereas EOG is abnormal. These are Best Vitelliform Macular degeneration and Butterfly.

Macular Dystrophy

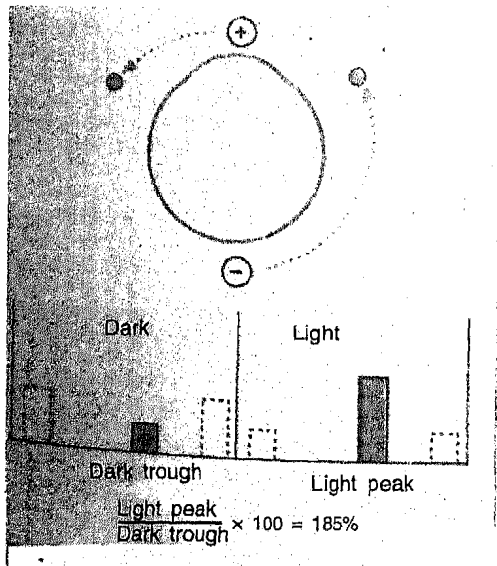


Fig. 17.5: EOG showing light peak and dark trough

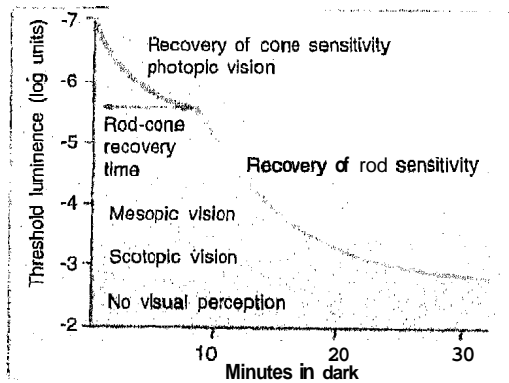


Fig. 17.6: Relation between dark duration and threshold luminance

Check Your Progress 3

1) What is EOG?

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- 2) What is Arden ratio? Give its normal range!

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17.5 LET US SUM UP

In this unit you have learnt ERG is the record of action potential produced by the retina. When light is thrown on the retina, an alteration in electrical potential occurs. An electroretinogram shows the changes that occur in the resting potential of the eye. The recording of changes in the resting potential of the eye is induced by a flash of light. This change is brought about by a composite of electrical activity of photoreceptors, Muller cells and retinal pigment epithelium (RPE). VER refers to Electro-encephalographic recording made from the occipital lobe in response to visual stimuli, It has two positive waves p1 and p2 and two negative waves v1 and v2. EOG is based on the measurement of resting potential of the eye which exists between the cornea (+) and back of retina (-) during fully dark adapted and fully light adapted condition. In next unit you will study about the biochemistry of the eye.

17.6 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

ERG records the change of resting potential produced by one retina when light is thrown on it.

Forms of ERG are:	Bright Flash
	Focal ERG
	Multifocal ERG
	Pattern ERG
Uses of ERG:	Retinal functions
	Refinal Degeneration
	Leber's Amourosis
	Tay Sach's Disease
	Diabetes
	Open angle glaucoma
	Toxic retinopathies

Check Your Progress 2

VEP has 2 positive waves P1 and P2 and 2 negative waves V1 and V2.

Check Your Progress 3

- 1) EOG is based on the measurement of resting potential of the eye which exists between the cornea (+) and back of the retina (-) during fully dark adapted and fully light adapted condition.

$$2) \text{ Arden ratio} = \frac{\text{Light peak} \times 100}{\text{Dark Trough}}$$

Normal range = > 185