CHAPTER 12 VISUAL ACUITY AND ELECTRODIAGNOSTIC TESTS

VISUAL ACUITY

Definition:
The capacity to discriminate the fine details of objects in the field of view.

SLIDE 95
SLIDE 96

Measurement:
The angle subtended at the eye by an object is considered the best measure of acuity, as it takes into account the dimension of the object and the distance at which the object is viewed. In practice, 'normal' visual acuity is the ability to discriminate a dimension which subtends one minute of an arc at the eye. The standard letters used for vision testing e.g. 'E' subtend an angle of 5' at the eye, but to identify the letter, the component dimensions of the letter must be discriminated and these subtend an angle of 1' at the eye. A viewing distance of six metres has been adapted as 'standard'. On the testing charts larger test objects are supplied, the dimensions of which also subtend 1' of arc but at greater viewing distances. If a person has 6/12 vision, it means that he can just respond at six metres to test objects discriminated by 'normals' at 12 metres. The Snellen chart is therefore used to test distance visual acuity. If the patient wears distance glasses they should be used for reading the chart and the use of glasses should be noted. If reading of the Snellen chart is poor but can be improved by the use of a pinhole, then the poor visual acuity is usually due to a refractive error.

Distance visual acuity can be tested in children and illiterate adults by using the Sheridan-Gardiner test which involves matching Snellen letters to those on a hand-held card. Alternatively the 'E' test can be used which involves the patient orientating a wooden E to match the orientation on the chart.

If a patient is unable to see the top letter i.e. has a visual acuity of less than 6/60, the patient should be moved closer to the chart. If the top letter can be read at 3 metres then the visual acuity is recorded as 3/60. If the letter can only be read at 1 m then the visual acuity is 1/60.

If the visual acuity is less than 1/60 the patient should be tested for counting fingers at 1m against a white background. If unable to count fingers the patient should be tested for hand movements (HM) perception of light (PL) or no perception of light (NPL).

Near visual acuity is tested (with the patient's reading glasses if needed) in good illumination at a comfortable reading distance using standard test type. It is recorded as N5, N8 etc.

Variables affecting acuity

A. Physical variables

1. Brightness of background
2. Illumination

B. Physiological variables

1. Size of pupil. Pupil size for best acuity is about 3mm. A larger pupil permits more light to reach the retina but heightens aberrations, due to the peripheral lens now becoming part of the light pathway. Smaller pupils in bright light eliminate most of the ocular aberrations.

2. Receptor distribution: Acuity is best when the image is formed at the centre of the fovea.

   There are 34,000 tightly packed cones in the foveola. As indicated earlier, there are no nerve fibres, ganglion cells, bipolar cells or blood vessels at this point, just cones, their nuclei and fibres.

ELECTRODIAGNOSTIC TESTS

A. The ERG - electroretinogram

SLIDE 97

Definition: The mass electrical response of the whole retina to light stimulus.

One electrode is attached to the eye using a piece of conductive material imbedded in a contact lens. A further electrode is placed on the forehead. The potential difference between these two electrodes is the ERG. The potential, when suitably amplified, can be recorded on an oscilloscope.

The ERG shows under dark-adapted conditions with a bright light:

SLIDE 98

1. a - wave, a negative potential
2. b - wave, a positive potential
3. c - wave, another positive potential
4. d - wave, a negative off effect

Usually only the a- and b-waves can be recorded with any certainty. Although the precise origins of the wave form are not known, it is currently thought that the a-wave is associated with receptors and retinal pigment epithelium, the b-wave is associated with the layers between the receptors and the ganglion cells, probably from Muller's cells and the c-wave with the pigment epithelium.

Clinical applications of the ERG:

1. To diagnose diseases causing widespread lesions of the retinal receptors and the retinal pigment epithelium, e.g. retinitis pigmentosa and generalised retinal disease. The ERG response may be subnormal, i.e. reduced to about 1/2 amplitude, or extinguished, i.e. not recognisable. The ERG is effective in detecting such receptor diseases before they are clinically manifest, or indeed before the patient has any visual complaints.

2. As a valuable index of retinal function in infants or in patients where medial opacities obscure the retina.

B. The EOG - electro-oculogram

This is an additional method of measuring retinal functions electronically. In this instance, the electrodes are placed at the inner and outer canthi of the eyes. As the eye moves from side to side an alternating potential difference is recorded. The potential difference is measured in the dark (small) and after exposure to light (large). The ratio is known as the light rise, and is a useful index of retinal pigment epithelium function.

C. The VER - visual evoked response

The VER measures, by the use of scalp electrodes, the electrical potential resulting from a visual stimulus. It is primarily a test of macular and optic nerve function. Abnormalities due to such conditions as demyelination can be detected. The VER can also detect and monitor amblyopia in infants.