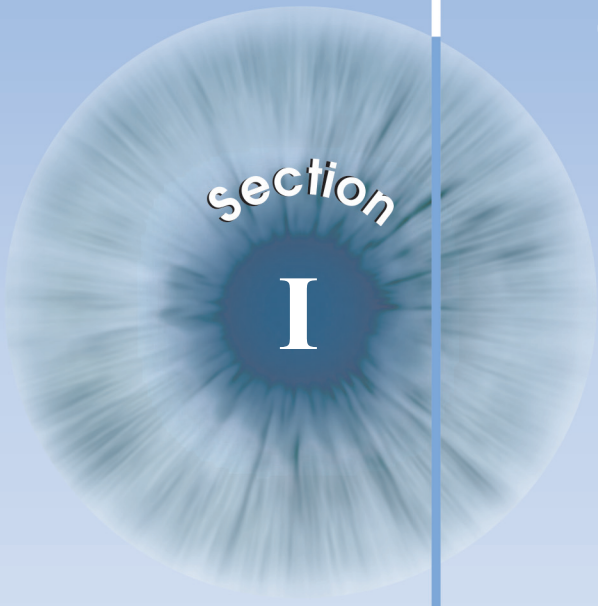

Clinico-investigative Neuro-ophthalmology

1 EXAMINATION OF A NEURO-OPHTHALMIC CASE

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INTRODUCTION

Examination of a neuro-ophthalmic case basically includes a thorough ocular, neurological and systemic clinical work-up and investigations including neuro-imaging to reach up at the proper diagnosis.

- *Visual loss,* i.e. either transient visual loss or visual impairment due to lesions of visual pathway and or cortical centers and psychosomatic condition.
- *Diplopia,* primarily because of palsies of cranial nerves supplying various extraocular muscles.
- *Visual field defects* due to various lesions of visual pathway.
- *Deranged higher visual functions* in the form of visual-hallucinations, illusions and agnosia.
- *Papilledema* is an important neuro-ophthalmic manifestation.
- *Anomalous pupillary reflexes* make up essential clues in a neuro-ophthalmic case.

In this text examination of a neuro-ophthalmic case is discussed as:

- Clinical investigative approach to a patient with visual loss, and
- Clinico-investigative approach for a patient with diplopia.

CLINICO-INVESTIGATIVE APPROACH TO A PATIENT WITH VISAUL LOSS

Visual loss can be broadly classified into

- Transient visual loss, and
- Visual impairment.

TRANSIENT VISUAL LOSS

Transient loss or blurring of vision in one or both eyes is not an uncommon visual complaint. The approach to such a patient is complicated by challenging differential diagnosis and overlapping disease profiles. It is an important sign of cerebrovascular diseases in some patients and

thus warrants a systematic approach in examining, investigating and treating such patients.

TERMINOLOGY

Transient visual obscuration (TVO), i.e. fleeting loss of vision lasting just a few seconds

Monocular transient visual loss includes:

- *Amaurosis Fugax*, i.e. partial or total (rare) monocular blindness lasting a few seconds to minutes.
- *Transient monocular blindness* refers to more prolonged (30 minutes to hours to days) episodes of partial or total loss of monocular vision.

Binocular transient visual loss includes episodes of bilateral loss of vision lasting from 5–30 minutes and occasionally longer, involving either homonymous field, inferior or superior altitudinal fields or the central fields.

CAUSES OF TRANSIENT VISUAL LOSS (TVL)

1. Non-ischemic causes of TVL

- *Ocular surface disorders* such as dry eye, blepharitis (anterior or posterior) and recurrent corneal erosions.
- *Corneal endothelial disorders* such as dystrophies and decompensation
- *Intermittent angle closure*
- *Uveitis*
- *Vitreous floaters*
- *Optic disc disorders* such as papilledema, papillitis, drusen and colobomas.

2. Ischemic causes of TVL

i. ***Embolic diseases***

- Carotid embolic diseases, e.g. atheromas and obstruction.
- Cardiac embolic diseases, e.g. valvular—rheumatic, prosthetic valves, fibrillation and myxomas.
- Great vessels embolic diseases, e.g. aortic arch embolus

ii. ***Vasculitis***

- Giant cell arteritis

iii. ***Hypoperfusion*** as seen in:

- Carotid obstruction
- Vertebrobasilar insufficiency
- Ocular ischemic syndrome

iv. ***Vasospasm,*** e.g. migraine

v. ***Hyperviscosity,*** e.g. polycythemia

vi. ***Hypercoagulability***

APPROACH TO A PATIENT WITH TRANSIENT VISUAL LOSS

1. History

A meticulous history is very important. It should include:

i. ***Age*****:** In less than 50 years of age vasospasm and migraine are the commonest causes of TVL and in more than 50 years of age carotid embolic disease is a common cause.

ii. ***Associated medical conditions*****:** To be enquired include hypertension, diabetes, coronary artery diseases and Raynaud's phenomenon.

Features of TVL:

- Monocular or Binocular TVL
- Duration of visual loss
- Number of episodes of visual loss
- Pattern of visual loss and recovery should be noted:
  - Shade or curtain coming down and then lifting is typical of amaurosis fugax due to carotid disease.
  - Positive visual phenomenon, e.g. scintillating scotomas in migraine.
  - Transient blurring of vision with exercise and increased body temperature is typical of *Uhthoff* phenomenon seen in optic neuritis associated with multiple sclerosis.
  - Abrupt change in vision may be associated with posterior circulation ischemia.

iii. ***Associated symptoms:*** To be noted include headaches, weight loss, fever, scalp tenderness, loss of consciousness, diplopia, dizziness, dysarthria and focal weakness.

2. Examination and Investigations in a patient with transient visual loss

In a patient with monocular visual loss

Examination tests include:

- Visual acuity
- Ocular motility in cardinal positions of gaze
- Orbital examination for proptosis. Gaze evoked blurring of vision is reported in intraconal mass lesions.
- Pupillary evaluation for RAPD, and anisocoria
- Slit lamp biomicroscopy for lids, lashes, cornea, anterior chamber (cells, flare), cataract and anterior chamber angle depth

- Applanation tonometry
- Gonioscopy to note open, closed or occludable angles
- *Fundus examination* for evalution of optic disc, retinal vessel calibre, emboli, and signs of ischemia (hemorrhages, cotton wool spots)
- *Auscultation* of carotids for bruit and cardiac murmurs
- Palpation of temporal artery
- *Pulse rate* and *blood pressure* recording

Investigations should include:

- Complete hemogram
- Erythrocyte sedimentation rate (ESR)
- C-reactive protein (CRP)
- Coagulation profile
- Lipidogram
- Serum glucose levels
- Carotid Doppler
- Magnetic resonance imaging (MRI)
- Magnetic resonance angiography (MRA)
- Carotid angiography—Gold standard for the assessment of carotid stenosis
- Echocardiography
- ECG, Holter monitoring

CLINICAL ENTITIES ASSOCIATED WITH TVL

Non-ischemic transient visual loss

- ***Ocular surface diseases and corneal abnormalities*** are one of the commonest causes of non-ischemic TVL. Patients usually complain of transient visual obscurations of vision at specific times of the day, many times a week and more so in certain seasons. Slit lamp exam reveals abnormal tear break up time, anterior or posterior blepharitis. Patients usually respond well to warm compresses, anti-inflammatory and antibiotic therapy of short duration supplemented with tear substitutes.
- Patients with ***corneal endothelial diseases and dystrophies*** report episodes of blurring of vision lasting many hours usually more pronounced in the mornings. Slit lamp exam, pachymetry and specular count are diagnostic. Hyperosmotic drops, ointments and IOP lowering drugs help in symptomatic relief. Lamellar or full thickness corneal transplants can completely cure symptoms.
- ***Intermittent angle closure*** is an important cause of episodes of TVL. Patients usually complain of episodes of transient blurring of vision accompanied by ocular discomfort, seeing colored haloes and mild headaches. Slit lamp exam to grade AC depth along with gonioscopy show occludable angles and help clinch the diagnosis. Symptoms are completely relieved by YAG peripheral iridotomy.
- ***Papilledema and optic disc drusen*** can be associated with episodes of transient visual obscurations or episodes of gray, black or white vision. The episodes are usually associated with changes in posture. The likely etiology for TVL in these cases is axonal compression/stasis at the elevated optic nerve head.
- ***Papillitis/optic neuritis*** is associated with TVS similar to cases of papilledema. The likely etiology is demyelination and inflammation of the optic nerve.

Ischemic transient visual loss

Characteristic of transient visual loss are:

- Ischemic transient visual loss occurs due to temporary interruption of the blood supply to the retina, optic nerve or retrochiasmal visual pathways in the brain.
- Patients tend to be more specific, descriptive and discrete about the pattern of visual loss and recovery—onset, duration, number of episodes, central or peripheral field involvement.

Carotid artery stenosis or occlusion is the commonest cause of ischemic TVL. Atherosclerosis is the commonest cause but other causes like Takayasu arteritis, trauma, radiation arteritis and carotid dissection should be kept in mind. Carotid related amaurosis fugax results either from emboli originating from the diseased proximal internal carotid segment to the retinal arterial circulation or from decreased blood flow to the retina. The typical features of embolic monocular TVL are sudden onset, painless, described as a shade or a curatin coming down on the field of vision which lifts and vision clears in 1–5 minutes (sometimes up to 30 minutes).

Emboli that cause TVL can often be visualized with an ophthalmoscope or slit lamp fundus biomicroscopy (78 D, 90 D lens) and often appear distinctive, their probable site of origin can be inferred which becomes crucial directing appropriate patient evaluation.

- *Cholesterol emboli (Hollenhorst plaques)* appear as yellow-orange refractile deposits at bifurcations of vessels and are typically a sign of carotid disease.
- *Platelet fibrin emboli* are dull grey or white in color, concave meniscus at each end, lodge along the course of vessel and are likely a result of carotid thrombosis, thrombosis associated with recent myocardial infarction or heart valves.
- *Calcium* emboli are chalky white in color, large round or ovoid, lodge in the first or second vessel bifurcations or may overlie the optic disc. They can arise from the heart (rheumatic heart disease, calcification of mitral valve) or great vessels (calcific aortic stenosis).

Stroke and transient visual loss

- The risk of stroke from *amaurosis fugax* per annum is approximately 2% and a 1% risk of permanent visual loss.
- In patients *with carotid stenosis*, ipsilateral eye symptoms may be accompanied by those *of ipsilateral cerebral ischemia* like contralateral hemiparesis, sensory loss, language deficits and hemianopia.

Clinical work-up

- ***General examination*** should include pulse rate (irregular in arrhythmias, fibrillation), cardiac auscultation (murmurs) and carotid auscultation (bruit). However, presence or absence of a carotid bruit is generally not helpful for diagnosing significant carotid stenosis or predicting a carotid source of emboli.
- ***Carotid ultrasound and Doppler*** are effective screening tools for identification and estimation of the degree of internal carotid artery stenosis.
- ***Magnetic resonance imaging–angiography*** (MRA) is another non-invasive test for carotid stenosis, however, it tends to overestimate the degree of stenosis.
- ***Computed tomographic angiography*** (CT angio) is another screening test and can be used to confirm MRA or ultrasound findings.
- ***Conventional angiography*** is the gold standard test for evaluation and quantification of carotid stenosis as its specificity and sensitivity exceed those of any non-invasive tests.
- In a elderly patient if the all the general workup including carotid tests are unrevealing then an atheroma arising from the more proximal vessels like the aorta or an acephalgic migraine should be considered as possible etiologies for TVL.
- In a young patient with an unrevealing work-up, vasospasm and hypercoagulable states, due to antiphospolipid antibodies, protein C, protein S and antithrombin III levels should be considered possible causes for TVL.

Treatment

If not contraindicated, antiplatelet therapy with aspirin should be immediately started in patients with amaurosis fugax to reduce the risk of stroke. Addition of clopidogrel or anti-coagulants can also be considered in consultation with an interventional cardiologist. Multiple clinical trials have established the benefit of carotid surgery for symptomatic (retinal or hemispheric TIA) carotid stenosis greater than 70%. The management of asymptomatic carotid stenosis is however extremely controversial.

VISUAL IMPAIRMENT

A patient presenting with diminution of vision without any evidence of structural abnormalities in the eye is a puzzle for an ophthalmologist. It is important to have a logical and meticulous approach to evaluate such patients so as to come to a conclusion regarding the cause of visual loss. This includes detailed history, thorough clinical examination and appropriate investigations.

COMMON CAUSES

Visual impairment can be broadly classified to belong to the following pathologies:

1. Refractive errors and media opacities
2. Lesions of visual pathway
   - Optic nerve lesions
   - Chiasmal lesions
   - Retrochiasmal lesions
3. Macular lesions
4. Amblyopia
5. Psychogenic/malingering

We will further see how to rule out each of them and come to a problem oriented working diagnosis. Figure 1.1 is the flow chart for assessment of visual impairment and segregating patients with refractive errors, media opacities.

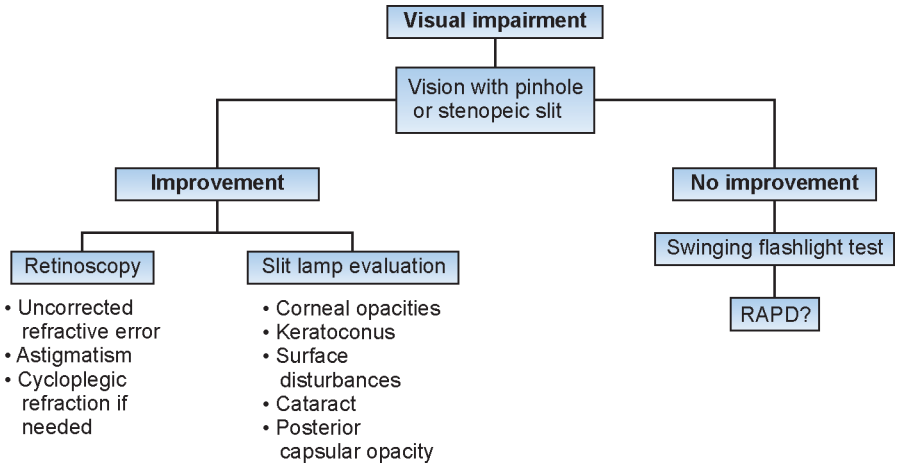

Fig. 1.1 *Flow chart for a patient with visual impairment.*

CLINICAL WORK-UP AND TESTS

TESTS FOR REFRACTIVE ERRORS, MEDIA OPACITIES AND VISUAL PATHWAY LESIONS

PINHOLE TEST AND STENOPEIC SLIT TEST

As refractive errors are one of the leading causes of decreased vision they should be the first ones to be ruled out. Use of pinhole and stenopeic slit determines whether or not vision will improve with refractive correction. Improvement by two lines on Snellen's chart or more on looking through the pinhole or stenopeic slit makes it clear that the visual impairment is due to optical problems.

As the pinhole eliminates paraxial rays of light, minimizing blurring of the image falling on the retina, all optical defects can be neutralized to some extent with this method, not only the refractive ametropias. However, many patients, especially children and old people find it difficult to peek through the pinhole and do not give reliable responses. The method is uncertain, and improvement of less than two lines should certainly be interpreted with caution. Repeated subjective and cycloplegic *refraction* will usually uncover an undetected and irregular corneal astigmatism or hypermetropic error.

- Limitations of pinhole are that vision may apparently worsen in patients with central media opacities (such as posterior subcapsular cataract) and macular pathologies. Vision does not improve to 6/6 if refractive error exceeds ±4 DS.
- Detailed slit lamp examination will reveal any obvious corneal opacities, surface irregularities, keratoconus and not to mention presence of cataract or posterior capsular opacity.
- If the vision does not improve with the pinhole, the next step will be checking the pupils for relative afferent pupillary defect.

SWINGING FLASHLIGHT TEST

This is performed to detect the presence of relative afferent pupillary defect (RAPD).

Remember: Relative = compared to the other eye, and Afferent = problem in the afferent pathway.

The main use of RAPD is in evaluating a patient who has decreased vision in one eye and normal vision in the other. If it is present, there is lesion in one of the eyes, or asymmetric optic nerve or retinal lesion. If it is not present, retina or optic nerve of both eyes are normal or symmetrically involved. But brisk pupillary reaction to light definitely rules out optic nerve pathology.

Technique of swinging flashlight test

The swinging flashlight test is performed as follows:

- *Patient is seated* in a dimly lit room and asked to fixate at a distant target. This provides maximum relaxation of the iris sphincter muscle.

- *Torchlight is shone* into one eye. The light should be directed from below so that it does not act like a near target and induce miosis associated with accommodation. It should be shone into the eye for about 2–3 seconds.
- *Pupillary reaction is observed* and the light is quickly moved across the bridge of the nose and directed into the opposite eye. If the light is moved too slowly; the pupil is seen to constrict when finally the light falls on it and thus gives a false impression of a normal reaction.
- *Pupillary reaction of the other eye is observed* and compared in amplitude and speed to the first eye.
- *The light should be moved across one eye to the other* briskly and rhythmically at least 5 times. This is important to be sure that any papillary dilatation on one side is not just the sphincter movement due to physiological pupillary unrest. The light should be bright, but not so bright that it makes the patient photophobic.
- *RAPD can be identified even in cases where the reaction of both pupils cannot be studied,* for example single eyed individuals, patients in whom one pupil is distorted, non-dilating and fixed or constricted due to neurological disease, iris trauma or synechiae.

Observations

While performing the swinging flashlight test, we observe the pupil that is being illuminated. But the opposite pupil also reacts in an identical manner. Thus in these cases the examiner must observe only the reactive pupil. If the abnormal eye is the eye with the fixed pupil, then the normal eye will react briskly when the light is shone into it and will dilate when the light is shone into the opposite eye. On the other hand, if the eye with the apparently normal pupil is the affected eye, then its pupil will dilate when the light is shone onto it and constrict when the light is directed on the other eye (with the fixed pupil).

Normal response (RAPD absent)

When light is shone into one eye, the pupil constricts. When it is transferred to the other eye, its pupil is either already constricted (due to consensual reflex) or constricts further. When it is shone back into the first eye, the same response takes place.

Abnormal response (RAPD present)

When light is shone into the normal eye, its pupil constricts. When light is transferred to the other abnormal eye, it will either consistently constrict more weakly compared to the normal eye; or does not react; or actually dilates on light stimulation (phenomenon called as pupillary escape); RAPD is said to be present. At this point the other eye's pupil will also be dilated.

Presence of RAPD means that cause of visual loss is unilateral or asymmetric bilateral retinopathy or neuropathy.

- Interpretation of presence of RAPD is shown in Fig. 1.2.
- On dilated fundus examination, a retinopathy severe enough to cause RAPD will be easily appreciated.
- However, optic neuropathy may be present in the absence of any fundus abnormalities.

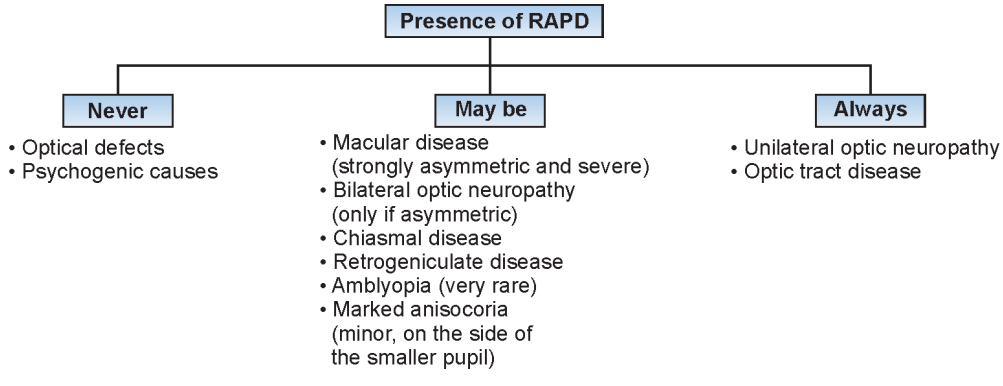

Fig. 1.2 *Interpretation of presence of RAPD.*

Retinal pathologies capable of causing RAPD are:
- Central retinal artery occlusion
- Central retinal vein occlusion
- Total retinal detachment

These will have substantial changes in the fundus and a careful dilated fundus examination can help differentiated them from neuro-ophthalmological disease.

If RAPD is absent, visual loss in these cases may be due to:
- Macular pathologies
- Amblyopia
- Psychogenic causes/malingering

Use of neutral density filters

The neutral density filters are available ranging from 0.3 log units to 2 log units; in steps of 0.3 log units. Neutral density filters can be used for:
- *Quantifying the RAPD.* The neutral density filters are placed in front of the normal eye. The density of the filter that neutralizes the RAPD is the measure of the defect.
- *Unequivocal findings.* The neutral density filters are successively placed in front of either eye. If RAPD is present in an eye it becomes more obvious when the filter is placed in front of that eye. If it is absent, when the filter is placed in front of one eye the pupil will dilate on shining light onto it; and this will repeat when the filter is shifted to the other eye, i.e. there will be an 'Artificially created RAPD'.

Grading of RAPD

- *Grade I.* A weak initial constriction and greater re-dilatation
- *Grade II.* Initial stall and greater re-dilatation
- *Grade III.* Immediate pupillary dilatation
- *Grade IV.* Immediate pupillary dilatation following prolonged illumination of the good eye for 6 seconds
- *Grade V.* Immediate pupillary dilatation with no secondary constriction.

Note

As mentioned before, the presence of a relative afferent papillary defect almost always confirms a neuro-ophthalmological cause, but the absence of it does not rule out the same. So either ways, we must go ahead with further optic nerve function tests which complement our findings and which assume special importance in case of unequivocal results or if pupil cannot be examined.

OPTIC NERVE HEAD EXAMINATION

A meticulous optic nerve head examination using slit lamp biomicroscope and high power lenses like 78 D or 90 D gives valuable information about the acuteness of the condition and to some extent the etiology.

COLOR VISION TESTING

Testing the color vision helps to differentiate optic nerve pathology from other pathologies. Usually in day-to-day clinical practice, Ishihara pseudo-isochromatic tests plates are used. Inability of indentifying a number at all is considered as defective color vision. The D 15 color vision test is based on a set of colored plates or disks which have to be arranged in the correct order. Tests like Farnsworth-Munsell 100 hue test and Hardy-Rand-Ritter (HRR) charts are more detailed tests which include various colors which have a very subtle difference of hue which the patient has to compare and obtain the nearest match. Though these tests can identify very early or fine changes, they are very time consuming and very difficult to carry out in day-to-day busy clinics.

To determine whether the color vision deficit is due to optic nerve involvement we need to note if:
- There is relevant history (acquired loss of color vision)
- Color vision worse in dim light
- Preferential inability to discriminate between red and green colors (in macular abnormalities there will be preferential loss of ability to differentiate blue and yellow colors).

Color saturation

To patients with optic nerve disease colors appear less bright, faded (desaturated) or darker in the affected eye than the normal eye. To check for this, a red stimulus (brightly colored stimulus preferred) is presented to each eye in succession and patient is asked if to one eye the color appears 'brighter' or 'richer' than the other. If the patient clearly says yes it is taken as a positive response. To the eye with defective optic nerve function the red color may appear as a faded color such as orange, pink or faded red (indicating decreased saturation) or brown, gray (indicating decreased brightness).

BRIGHTNESS COMPARISON TEST

This test detects decreased brightness sensitivity in the affected eye if any. Bright torchlight is shone into each of the eyes and patient is asked which appears brighter. Taking the brighter one as 100% patient is asked to compare it with the other eye and determine how much is the decrease in the brightness perception in the other eye. This test is slightly more sensitive than the RAPD and may help detect an early defect.

CONTRAST SENSITIVITY TESTS

Visual acuity determines the smallest spatial detail that can be resolved for a high contrast stimulus, whereas measurement of contrast sensitivity checks the responses of visual system to different sizes and contrasts. These tests are thus useful adjuncts to reveal the deficit in patients with normal visual acuity but who may have a visual pathway lesion.

- It is usually determined by measuring the contrast thresholds for sinusoidal gratings, an alternating pattern of light and dark bars, the luminance of which varies sinusoidally in a direction perpendicular to the orientation of the grating. The size of the grating is specified according to the spatial frequency which is the number of cycles of the grating pattern (i.e. the pair of dark and light bars) per degree of visual angle. The contrast sensitivity function measures between 3 and 10 spatial frequencies from 0.5 to 30 cycles per degree.
- Other tests available to measure the contrast sensitivity are Pelli-Robson contrast sensitivity chart, Vistech contrast sensitivity chart and a low contrast version of the Bailey-Lovie visual acuity chart. These charts make use of contrast letters to measure contrast sensitivity. However, whether these tests are superior to the ones using sinusoidal gratings to measure contrast sensitivity is controversial.

Note. One must note that sensitivity losses have little specificity for differential diagnosis purposes. Similar patterns of loss can be obtained by a wide variety of conditions and at the same time many types of disorders can produce similar amounts of visual acuity loss.

VISUAL FIELD TESTING

Confrontation test

The next step is to determine any defect or decreased sensitivity in the visual fields. This can be done in the OPD performing the confrontation test which is done as follows:

1. ***Patient should be comfortably seated.*** The clinician is seated about 1 meter in front of and at the level of the patient, who is asked to fixate on the bridge of the examiner's nose. While testing patient's right eye, his left eye should be occluded and the clinician's right eye should be closed.

2. ***Firstly ask the patient*** if he can see the examiner's full face clearly. If not, then ask him to elaborate which parts are missing or not clearly visible to him. This will tell us about any gross defects in the field of vision.

3. ***Testing of single quadrants.*** One or two stationary fingers are presented randomly in each quadrant of the right eye taking care that the stimulus remains well within 30 degrees of the visual field; and the patient is asked to count the fingers. Children can be asked to simulate the number of fingers seen and at the same time the examiner looks for the eye movements brought forth by the stimulus.

4. ***Delineating the scotoma.*** If the patient is not able to see the fingers—move the finger from the defective quadrant slowly towards the vertical meridian. Patient is asked to identify as soon as he sees the stimulus. This way we can recognize if the border of the defect is aligned to the vertical meridian. Same procedure should be repeated to if there is presence of a defect respecting the horizontal meridian.

Steps 2, 3, 4 are repeated in the left eye.

5. ***Testing double quadrants.*** This is performed if the patient correctly identifies stimuli in single quadrant testing but the clinician suspects presence of defect in a certain quadrant. One or two fingers of both the hands are simultaneously presented in two different quadrants and the patient is asked to count the total number of fingers seen.

6. ***Brightness comparison.*** If the patient responds correctly to the above tests he may be asked to compare the clarity or brightness of two fingers simultaneously presented in two different quadrants and if there is any reduction in brightness of one of them.

7. ***Red desaturation test.*** Two identical bright colored objects (preferably red) are presented to the patient in two different quadrants and asked if there is any difference in the brightness of the color in any of the quadrant. If yes, the object is moved slowly from the defective quadrant towards the vertical meridian and the patient is asked if the object becomes brighter or duller in the course. If there is marked difference, a hemianopic defect exists. Same maneuver is repeated with the horizontal meridian.

The confrontation test gives a rough idea about presence of any gross visual field defects. It has very less specificity and sensitivity as it depends largely on the patient's ability to understand how to perform the test and maintain fixation. Though it should never replace formal visual field testing, it assumes importance in certain scenarios like examination of a bed ridden patient where technical investigations may not be possible.

Automated visual field examination

One of the most important investigations in neuro-ophthalmology is the automated visual fields examination. Central 30 degrees of field testing in standard automated perimetric programmes is preferred.

Visual field analysis must be considered

1. If RAPD is present
2. If any of the adjunctive clinical tests (color vision, color saturation, brightness sensitivity, contrast sensitivity) are abnormal
3. Optic nerve head examination shows pallor/edema/optic atrophy/glaucomatous changes

Visual field examination helps greatly to quantify the defect and localise the lesion along the afferent visual pathway and thereby can be called an important part of visual testing.

While trying to localize the lesion we must try to differentiate between a non-hemianopic and hemianopic defect. The loss of entire hemifield is not necessary for the diagnosis of hemianopic defect, it is enough that the border of the defect is aligned to the vertical fixation meridian. If the field defect is hemianopic, it points towards the cause of an optic neuropathy or retinopathy, whereas a hemianopic defect would point to a chiasmal lesion.

TESTS FOR MACULAR PATHOLOGIES

Tests that can be used to rule out macular pathologies are as follows.

Amsler's grid test

In the standard Amsler's grid chart the patient is presented a grid of black lines on a white background and a central black dot for fixation at a reading distance. The patient must wear his refractive correction. First the patient is asked if he can see the central dot. He is then asked to mark on the chart if any of the squares seem bent or distorted or of unequal sizes; or if he is unable to see any parts of the grid. The presence of metamorphopsia is diagnostic of macular disease, as it is caused by the separation, distortion or crowding of foveal cones by edema, fluid or scarring.

There are other types of Amsler's grids:

- White squares on black background and central white dot
- White squares on a black background with a central white dot and diagonal white limits of his scotoma
- Red squares on a black background with a central red dot. This chart helps to diagnose optic nerve, chiasmal, or toxic amblyopia related problems.

Photostress test

Baseline visual acuity of the patient is determined. Bright light is directed into one of the eyes for ten seconds. This bleaches the photoreceptors. After ten seconds the patient's Snellen's visual acuity is recorded again. The time between bleaching and recovery to within one Snellen line of the original visual acuity is measured. If the time taken to recover is substantially greater in one eye than the other, it indicates impaired regeneration of photoreceptor pigment in the retinal pigment epithelium. However, this is a highly subjective test and can hardly be relied upon for the diagnosis.

Electroretinogram (ERG)

In the standard full field (Ganzfield) ERG the potentials are excited by short flashes of light and detected by recording electrodes contacting the anterior surface of the eye. The stimulus covers the entire retina, and the recorded responses are a summation of the electrical potentials generated

by the entire retina. It thus is a mass response and will detect generalized outer retinal disease and fails to detect isolated macular or other localized pathologies. Multifocal ERG (Mf ERG) is the new specialized type of ERG which is capable of highlighting such localized pathologies.

This is useful in determining the cause of visual disabilities when there are no visible findings on ophthalmoscopy.

Fundus fluorescein angiography

This is done to identify subtle macular lesions and vascular pathologies and is capable of detecting defects in the RPE and choroid too. It occasionally spots lesions not visible even on high magnification ophthalmoscopy.

TESTS FOR AMBLYOPIA

If there is absence of retinal lesion, the visual loss can be attributed to amblyopia. Amblyopia refers to poor vision caused by abnormal visual development secondary to abnormal visual stimulation.

History of squinting or cataract in childhood or congenital ptosis which occludes the visual axis may give a clue towards the presence of amblyopia. Binocular amblyopia may be considered in the cases of children with high hypermetropia. There are no confirmatory investigations for this entity and the diagnosis of amblyopia is made when all other causes are ruled out. A few simple clinical tests may aid in the diagnosis:

Testing for 'crowding phenomenon'

An amblyopic patient when asked to read single letters, is said to have a higher visual acuity then when he is asked to read an entire line. This is called *crowding phenomenon*.

Neutral density filter test

A 2 log unit neutral density filter is used in this setting. It is placed in front of the normal eye and the visual acuity is checked. It causes a drop in the visual acuity. When the same procedure is repeated in front of the other suspected amblyopic eye, it degrades the visual acuity less.

Base out prism test

This test detects the presence of a central fixation scotoma <5 degrees and is not specific for amblyopia. A 4 PD prism is placed in front of the normal eye in the base out position. The image is thus shifted temporally in that eye. There is bilateral vergence movement away from the eye behind the prism to take up fixation and similar movement of the other eye. However, since the image falls within the small scotoma the eye does not show any refixation movement. Similarly, when the prism is placed in front of this eye, there is no movement of either eye.

NEUROIMAGING

Neuroimaging is essential in certain scenarios to come to the correct diagnosis. It should be considered in cases of:

1. *Acute loss of vision*; unilateral (suspicion of hemorrhagic, ischemic, embolic phenomenon) or bilateral (suspecting a lesion above the level of chiasma)
2. *Hemianopic field defects* on visual field analysis indicating chiasmal lesion
3. *Trauma*; to rule out hemorrhage, fractures, optic nerve injury or compression
4. *Suspicion of compressive pathology.*

The choice of imaging modality depends upon the clinical diagnosis, available facilities and the cost factor. Magnetic resonance imaging (MRI) and computed tomography (CT) are the most commonly ordered investigations by a neuro-ophthalmologist.

Magnetic resonance imaging (MRI)

MRI is the investigation of choice in neuro-ophthalmology; especially for a patient with acute vision loss. It is more useful in:

- Identifying small lesions
- Identifying vascular lesions
- Characterization of lesion
- Extent and invasion of surrounding lesion
- Surgical planning if necessary

MRI offers better delineation of soft tissues and thus an improved differentiation between retrobulbar soft tissues (fat, muscle and optic nerve), between normal components of the brain (gray and white substances) and between differing forms of pathological change (infarction, hemorrhage, inflammation, and neoplasms).

MRI with gadolinium contrast enhances the blood vessels, extraocular muscles and active lesions and is preferred in this setting.

The most important advantage of MRI scanning lies in the fact that the signal strength in the image determined by tissue-specific parameters, the T1 and T2 relaxation times. This produces a high-resolution image with excellent tissue identification. Normal anatomy is best demonstrated in **T1-weighted** images, whereas **T2-weighted** images are better for demonstrating intracranial or other pathology.

Magnetic resonance angiography (MRA) *and* ***Magnetic resonance venography (MRV)*** are performed when the MRI does not yield any results but there is a strong suspicion of vessel pathology.

Absolute contraindications to MRI:

- Cardiac pacemakers
- Incorporated ferromagnetic foreign bodies/implants
- Shrapnel wounds
- Aneurysm clips of uncertain origin.

Computed tomography (CT)

CT is the imaging method of choice for patients with skull/brain injuries. The presence and course of fractures in the orbit can be studied, using the windows that allow the best definition of bones' anatomy (**Bone window**). The effects of direct ocular trauma, or retrobulbar hemorrhages, are best studied when using the window settings for soft tissues (**Soft tissue window**). Thus, ophthalmic vein distension may be detected because of a traumatic carotid cavernous fistula.

In soft tissue tumors where we expect calcification or hyperostosis (like meningioma) or an orbital tumor CT scan is a better choice of investigation. Also for detection of foreign bodies CT scan is preferred as such cases are a potential contraindication for MRI.

CT with contrast is done for better visualization of blood vessels.

Contraindication of contrast: It is important to remember the contraindications for the use of contrast materials:

- Allergy to iodinated compounds
- Hyperthyroidism
- Poor renal function
- Paraproteinemia

SUMMARY

If all the above mentioned causes of visual loss are eliminated with the aid of clinical tests, visual field examination, neuroimaging and other diagnostic investigations; and still no cause is found; the visual loss can then be attributed to psychogenic causes.

It is often tempting enough to refer such a patient with unexplained visual loss to the neuro-ophthalmologist but what is essential is a systematic and rational approach to come to a working diagnosis and thus save the patient of anxiety, dissatisfaction and expenses.

Clinico-investigative approach to a patient with visual loss is summarized in Fig. 1.3.

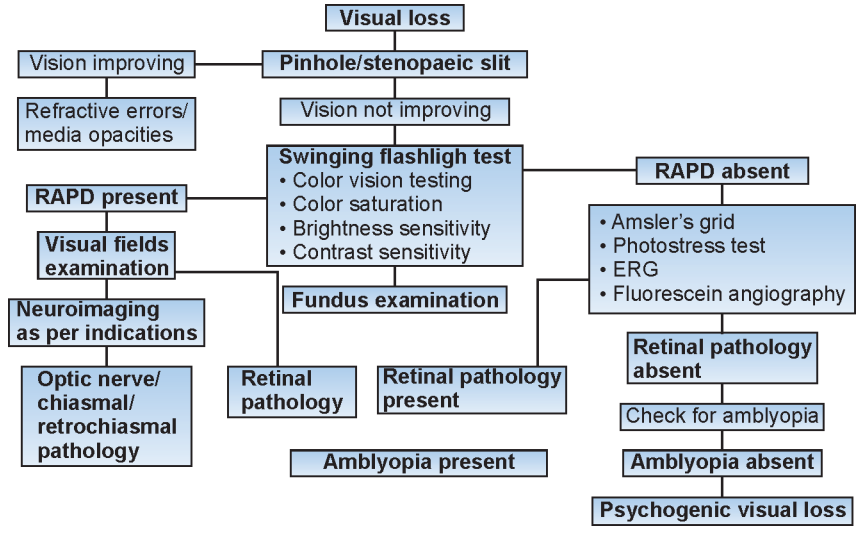

Fig. 1.3 *Summary of clinico-investigative approach to a patient with visual loss.*