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## *What is New in the Management of Vertigo*

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**Abstract:** Advances in diagnostic modalities have revolutionized the management of vertigo. Newer investigations of the vestibular system such as Videonystagmography, Vestibular Evoked Myogenic Potentials (VEMP), Vestibular evoked potential (VbEP), Brain Electrical Activity Mapping (BEAM) have helped us to investigate areas of the vestibular system such as statoconial organs. The vestibulospinal tract also comes under the purview of these investigations. Cerebellopontine angle endoscopy, a minimally invasive technique has helped the clinician diagnose even minute lesions predisposing to vertigo, such as vascular loop compression of the eighth nerve. This article highlights the role of newer diagnostic modalities and treatment strategies.

### **INTRODUCTION**

Vertigo can be an extremely challenging problem. The balance system is a multi-organ, multisystem mechanism and includes the central nervous system, peripheral nervous system, musculoskeletal system, visual and vestibular system. 3-5% of patients coming to the general practitioner, 10-15% of patients presenting to the neurologist, and 25-30% of patients visiting otolaryngologists present with neuro-otological problems such as vertigo.

### **OVERVIEW OF THE BALANCE SYSTEM**

The sensory mechanisms that contribute to our sense of balance and orientation are visual, vestibular and proprioceptive. The vestibular system has a specialized receptor organ—the membranous labyrinth which has mechanoreceptors (hair cells) located in the ampulla of the three semicircular canals and in the macula of the utricle and saccule. These identify and detect changes in the position of the head and body, both at rest and in motion and provide this information to the central nervous system about the spatial orientation of the subject. The CNS initiates a corrective action of the eyes by the vestibulo-ocular reflex, and the skeletal system by the vestibulospinal reflex system. Vertigo results when there is a mismatch between information about spatial orientation received from the vestibule with information received from other sensory systems due to a defect anywhere along this pathway.<sup>1</sup>

Often, the etiology of vertigo is not understood. A thorough history still remains the most important diagnostic tool and helps diagnosis in 70% of patients (Table 43.1). Investigations help in 10-15% of patients. Certain causes of dizziness present with a classic history. A spinning sensation indicates true vertigo and directs investigations towards abnormality of the vestibular system.<sup>2</sup>

The different features and causes of vertigo are given in Tables 43.2 to 43.4.

**Clinical examination includes:**

- ENT and head, and neck examination.
- Gait, Romberg's and Unterberger's test.
- Nystagmus—Spontaneous and induced (Gaze test, Dix-Hallpike positional test, positioning tests, fistula test, head shaking test).
- BP record.
- Examination of cranial nerves, neurological assessment.

**MANAGEMENT OF VERTIGO**

Investigations will depend on the history and findings on clinical examination.

Currently, new diagnostic modalities and therapeutic options are becoming increasingly important in the management of vertigo. If a vestibular cause is suspected, the following investigations may need to be done:

- **Audiometry**, including Brainstem Evoked Response Audiometry (**BERA**). BERA is an important tool in investigation of cerebellopontine angle lesions. They have a sensitivity of > 95% and specificity of > 90%. Characteristic delay in latency occurs in retrocochlear lesions, e.g. acoustic tumors, meningioma, arachnoid cysts.
- **Evaluation of functional integrity of vestibular reflexes**
  1. Vestibuloocular reflex—By electronystagmography or videonystagmography.<sup>3</sup>
  2. Vestibulospinal function—By craniocorpography and computerized dynamic posturography.
- **Monitoring electrical activity of brain** when the brain is processing vestibular input—Vestibular Evoked Myogenic Potentials (VEMP), Vestibular Evoked Potential (VbEP), Brain Electrical Activity Mapping (BEAM).
- **Imaging**—CT scan, MRI and MRA help detect intracranial lesions including vascular loops compressing the vestibular nerve. In the future, functional imaging, e.g. f-MRI, PET scans and SPECT may prove to be important diagnostic tools in evaluating the functioning of the vestibular pathways.
- **Laboratory tests** - Hemogram, thyroid function tests, lipid profile.

Several tests for assessment of vestibular system are in vogue. However, they have limitations—findings of these tests may not correlate with the severity of vertigo.

- With **electronystagmography**, the minute electrical changes in corneoretinal potential brought about by eye movements are used for recording eye movements on a moving strip of paper. It helps assess the integrity of vestibulo-ocular reflex and allied reflex systems, e.g. smooth pursuit, optokinetic and saccadic system. Its limitation is that it does not assess the vestibulospinal system.
- **Caloric tests** assess the horizontal semicircular canal and the superior branch of vestibular nerve.
- With **videonystagmography (VNG)**, eye movements are recorded by an infrared video camera and converted into a digital format through software that documents the eye movements. It is one of the recent diagnostic tools in the evaluation of vertigo. It has the advantages of accuracy of 0.1-0.5 degrees, contact-free recording of eye movements and can record rotatory eye movements not possible by ENG.
- **Craniocorpography** consists of photographically recording the patient's head and eye movements as he performs the Unterberger's and Romberg's test.
- **Computerized Dynamic Posturography** is a series of vestibulospinal tests which assess the sensory system, CNS and musculoskeletal dysfunction. It measures the influence of each component involved in the balance process by assessing the patient's ability to stand in situations of increased difficulty.

- **Vestibular Evoked Myogenic Potentials (VEMP)** is an otolith-mediated short-latency reflex recorded from averaged sternocleidomastoid electromyography in response to intense auditory clicks. It is increasingly used in the evaluation of patients with vertigo and helps in the diagnosis of peripheral and central vestibulopathies. It helps in evaluation of the saccule, inferior vestibular nerve and vestibulocollic pathway (lower brainstem function).<sup>3</sup> It helps in differentiation of labyrinthine from retro-labyrinthine lesions, monitoring the efficacy of intratympanic gentamycin treatment and can be used in intraoperative, neurophysiological monitoring. VEMP is attenuated in Meniere's disease, aminoglycoside ototoxicity, vestibular schwannoma, basilar artery migraine, Mondini malformation, vestibular neuritis. It is increased in early Meniere's disease, Superior semicircular dehiscence syndrome and perilymphatic fistula. VEMP can be delayed in technical error, central lesions (brainstem stroke, multiple sclerosis, spinocerebellar degeneration, migraine).
- **Electrocochleography** is the diagnostic tool in evaluating Meniere's disease and records the electrical events generated within the cochlea or by primary afferent neurons of the eighth nerve.

### Management

This depends specifically on the etiology of vertigo. Reassurance plays a very important part in the management of vertigo. Drug therapy is mainly directed towards relief of symptoms rather than modifying the underlying etiological process. Most cases of vertigo due to vestibular etiology respond to pharmacotherapy to provide symptomatic relief – anticholinergics, antihistamines, monoaminergics, antidopaminergics, calcium antagonists, benzodiazepines, vasodilators (betahistine-histamine analogue), diuretics and salt restriction in Meniere's disease.

### Particle Repositioning Maneuvers

In **Benign Paroxysmal Positional Vertigo (BPPV)**, particles dislodged from degenerated otolith organs enter the semicircular canal and cause vertigo. Most patients do well with medication and Particle repositioning maneuvers such as Epley's maneuver, Semont's liberatory maneuver Brandt Daroff positional exercises, which aim to send the dislodged particles back into the utricle.

### Surgery

Surgery is indicated in a very small group of patients whose vertigo is refractory to medical management.

### Meniere's Disease

Meniere's disease is characterized by endolymphatic hydrops.<sup>4</sup> Surgery is indicated in a small number of patients refractory to pharmacotherapy, including betahistine, diuretics and a salt-restricted diet. **Meniett pressure apparatus** is a small portable low pressure pulse generator which delivers low pressure pulses into the external auditory canal to restore normalcy in the inner ear's hemodynamic system. Intratympanic infusion of corticosteroids is a promising and relatively new therapy which allows local application of medications directly to the inner ear by absorption across an intact round window membrane, avoiding the need for systemic administration and is indicated for autoimmune inner ear disease. **Intratympanic infusion of gentamicin** in Meniere's disease helps in vertigo control in 87% but leads to hearing loss in 21% (0-37%).<sup>5</sup> **Endolymphatic sac decompression** can be done in patients with good hearing, and has a success rate of 60-70%.<sup>6</sup> **Translabyrinthine vestibular nerve section** has a success rate of almost 100%, but causes complete loss of hearing. **Cerebellopontine angle endoscopy with endoscopic selective vestibular neurectomy** is a minimally invasive technique which has the advantages of hearing preservation, as well as a very good success rate in controlling vertigo.<sup>7</sup>

Unilateral deafferentation of dysfunctional vestibular labyrinth occurs, so the CNS is better able to compensate for a complete loss of vestibular function than a fluctuating partial loss. It is

indicated for Meniere's disease, recurrent vestibular neuronitis, traumatic labyrinthitis and is contraindicated in bilateral peripheral vestibular disease, vertigo from an only hearing ear, CNS pathology e.g., multiple sclerosis, physiologic old age, and poor general medical condition. CP angle endoscopy has simplified the management of intractable vertigo. Hitherto unsuspected causes of vertigo e.g., vascular loop compressing the VIII nerve are being increasingly recognized by CP angle endoscopy.

**Microvascular decompression of vascular loop** pressing on the eighth nerve and causing vestibular dysfunction aims at separating the offending loop from the nerve and interposing connective tissue or Teflon sponge.

In BPPV, the introduction of particle repositioning manoeuvres has made surgical options such as selective denervation of the posterior semicircular canal (Singular neurectomy) or plugging the canal to isolate it (posterior semicircular canal occlusion) obsolete.

Vestibular compensation occurs after a peripheral vestibular disorder leading to abatement of symptoms. **Vestibular rehabilitation therapy (VRT)** enhances and expedites central compensatory mechanisms by increasing sensory conflicts—(mismatch of sensory inputs to the vestibular system caused by head/body/eye movements) which enhance compensatory mechanisms. Patient is advised certain exercises involving head/body/eye movements devised by Cawthorne and Cooksey,<sup>8</sup> and modified later by Brandt. VRT is a highly effective therapy for elderly patients with presbyastasis (dysequilibrium secondary to age related changes of the peripheral and central organs of balance).

## CONCLUSION

Several new and exciting developments are in the offing in the management of vertigo. Newer investigative modalities are now helping us understand labyrinthine dysfunction with a much greater degree of accuracy than was hitherto possible. With the advent of endoscopes, minimally invasive techniques have also improved diagnosis and management of pathology in the cerebellopontine angle.

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