

The diagnostic tools for vestibular assessment

The goal of assessing the patient with vestibular symptoms is to determine if the disorder is unilateral or bilateral, what end organ is contributing to the disorder and the severity of the disorder, and assessing recovery after the onset of the disorder. The ability to quantify the disorder assists in diagnosing the patient. In the past, the caloric test and the passive whole-body rotation tests have been complementary. These tests assisted in the diagnosis of peripheral disorders and determining if the disorder is unilateral or bilateral as well as the severity of the disorder. The caloric test was first described by Bárány in 1906. The caloric test in the past was the only test which allowed for ear specific testing. Rotational chair testing was first introduced by Bárány in 1907. The rotary chair was used to expand the evaluation of the peripheral system allowing for the assessment of the vestibular ocular reflex (VOR) and distinguish between true bilateral vestibular lesions and false-positive caloric reduction due to poor irrigations. The rotary chair was at the time the only test assessing frequencies above what the caloric test assessed. Rotary chair also allowed for the assessment of the difficult to test patients especially when caloric testing was not possible.

Recent advances in vestibular assessment have resulted in the discovery and development of more diagnostically useful tests. These tests assist in the diagnosis of peripheral disorders and determining if the disorder is unilateral or bilateral, the severity of the disorder as well as the origin. In the 2000s, cVEMP (cervical vestibular evoked myogenic potential) and oVEMP (ocular vestibular evoked myogenic potential) have been researched by many in Australia, Japan and US. In 1988, Drs. Halmagyi and Curthoys described the head impulse test. Impulse is portable so there is no limitation to where you assess the patient making it easy for assessment at the bedside, in the emergency room, as well as the clinic. These new tests, Impulse and VEMP, have a much smaller footprint than rotary chair and are much less expensive.

Comparison of Caloric versus Rotary Chair testing:



Caloric

- Very low frequency stimulus (~ 0.025 Hz) and accelerations less than $10^\circ/\text{sec}^2$
- Test time ~ 30 minutes

Advantages

- Ear specific

Disadvantages

- Tests at frequency/acceleration well below the level the vestibulo-ocular reflex functions in daily activities
- Absent caloric responses do not mean completely absent peripheral function
- Only detects cases of peripheral vestibular loss in lateral semicircular canals
- Stimulus can persist between irrigations especially if not performed properly
- Calorics can cause adverse reactions so some patients will not tolerate caloric testing or will not allow the caloric test to be completed
- Anatomical anomalies such as tympanic membrane perforations and middle ear disorders may prohibit performing the test
- Serial testing for monitoring function over time can be difficult to impossible
- Dependent on lack of visual fixation (total darkness)



Rotary Chair

- Mid Frequency stimulus (0.1 to 1 Hz) It has been stated that testing above 1 Hz is unreliable.
- Test time ~ 30 minutes

Advantages

- Can test patients with middle ear disorder
- Can test difficult to test patients including young patients and patients that will not tolerate calorics
- Distinguish between true bilateral vestibular lesions and false-positive caloric reduction
- Evaluate changes in the VOR function over time (serial testing)
- Ability to use off-axis or eccentric rotation to assess utricular function
- Can test visual-vestibular interaction

Disadvantages

- Test canals simultaneously (not ear specific so cannot distinguish unilateral from bilateral disorder)
- Only detects cases of peripheral vestibular loss in lateral semicircular canals with the exception of eccentric rotation for utricular testing.
- Is mostly insensitive to common vestibular lesions which are mostly unilateral in origin
- Test can result in adverse reaction
- Total body rotation assumes the head is completely fixed and therefore the stimulus delivered to the body is the same as delivered to the head. This assumption becomes unreliable at frequencies above 1 Hz.
- Physical space needed for a rotary chair and cost of the equipment can be a limitation

Comparison of tests available today:



Caloric

The limitations to caloric testing are mentioned above, however, since caloric testing uses a low frequency stimulus and is a thermodynamic response it is still seen as valuable in the assessment of Meniere's disease.



Impulse

- Tests the VOR with high frequency stimuli replicating the patient's everyday situations (physiological stimulus)
- Test time ~10 minutes when assessing all 6 canals

Advantages (best of caloric and rotary chair testing)

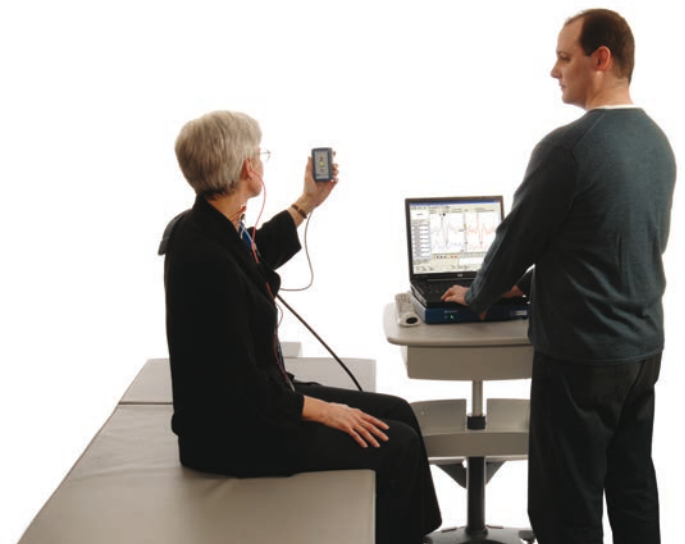
- Ear specific – can determine if the loss is unilateral or bilateral
- 6 semicircular canals assessed to detect abnormalities in cases with peripheral vestibular loss (Lateral, Anterior and Posterior) – localizes the lesion
- Ability to test patients even if they have middle ear disorders
- Ability to test patients who do not tolerate calorics (young children, elderly, or patients with severe hearing loss)
- Stimulus does not persist between tests
- Does NOT cause adverse reactions which makes it excellent for serial testing
- Can test in various light conditions

VEMP

- Research has shown that air-conducted cVEMP assesses the saccule and it is believed oVEMP assesses the utricle.
- Test time 5-10 minutes to assess the otolith organs
- "oVEMPs provide a powerful test for discriminating between healthy subjects and patients with chronic unilateral vestibular loss."*
- Research has compared oVEMPs to eccentric rotation and concluded "oVEMPs are generally easier and cheaper to administer than eccentric rotation tests, and are more comfortable for the patient, making them an attractive component of comprehensive vestibular testing."*

Advantages

- Ear specific – can determine if the loss is unilateral or bilateral
- Detects abnormalities in the otolith organs and branches of vestibular nerve and localizes the lesion in cases with peripheral vestibular loss
- Ability to test patients even if they have middle ear disorders using bone conducted stimuli
- Ability to test patients without adverse reactions making it possible to test young children & elderly
- Does not cause adverse reactions which makes it excellent for serial testing



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