



Quick Guide

Vestibular Diagnosis and Treatment Utilizing Videonystagmography (VNG)

Caloric Irrigation

Purpose of Test:

The purpose of caloric irrigation is to identify the degree to which the vestibular system is responsive and also to determine how symmetric the responses are, between left and right. It is a test of the lateral semicircular canals alone -- it does not assess vertical canal function or otolithic function. By using caloric irrigation, you are stimulating each end organ independently of the other to determine whether one end organ is weaker than the other (asymmetry) or whether neither end organ is providing sufficient vestibular information to the brain.

Considerations:

- Pre-test instructions/medications – There is conflicting literature on whether patients should be asked to discontinue central nervous system suppressant medications for 48 hours prior to the VNG. Part of this debate is that patients often don't understand which medications are allowed and which are not allowed. A general rule of thumb is that the patient should stop taking medications that are prescribed for "dizziness", but continue to take other medications (such as heart medications, blood pressure medications, etc...).
- A thorough examination of the external ear canal and tympanic membrane is necessary prior to irrigation. The three most important factors to consider are the presence of cerumen, the presence of a tympanic membrane perforation, and the shape of the ear canal. If excessive cerumen is present, it might preclude the stimulus from reaching the inner-most portion of the ear canal and could therefore prohibit a reliable test result. Removal of even the smallest amounts of cerumen is beneficial to the testing process. In the presence of a TM perforation, caloric stimulation by water cannot be completed. Stimulation by air can be performed only briefly to determine whether or not a vestibular response is present; however, accurate unilateral weakness and directional preponderance measures cannot be calculated. Examination of the shape and curvature of the ear canal is essential to reliable test results for two reasons: (1) Because the irrigator tip is straight and ear canals rarely are, it is not uncommon for the insertion of the irrigator tip to cause slight discomfort to the patient (2) It is important for the stream of air/water from the irrigator to be directed near, but not directly on, the tympanic membrane to avoid injury to the patient. Without a thorough examination of the ear canal, it is impossible to know whether the achieved test results are an accurate assessment of the vestibular system.
- It is necessary to perform VNG with the patient in a vision-denied state to disallow fixation suppression of the nystagmus response
- Alerting tasks are also necessary to discourage the patient from suppressing the nystagmus. The most effective alerting tasks require the patient to use recall memory – i.e. "name a state that begins with the letter ____..." , "name a color that begins with ____", "name a city in the state of _____", etc...
- It is suggested that you begin with warm irrigations (which provide an excitatory response) if for no other reason than if the patient cannot tolerate bi-thermal irrigation, the examiner has AT LEAST enough information to provide a score for the Monothermal Warm Screening Test (MWST).

- MWST is a *screening* test used mainly for patients who cannot tolerate bi-thermal testing. It is a percentage of asymmetry derived from only the warm-caloric irrigation responses.
- You should wait between 3 and 5 minutes between irrigations, as the nystagmus from the previous test must be completely resolved before you perform the next irrigation. It is suggested that you look at the eyes during the rest periods to watch the nystagmus dissipate. Removal of the mask cover during these rest periods can be helpful to allow the patient to suppress any residual response.
- A “fixation period” of 10 seconds is recommended as a diagnostic tool during the recording of the caloric response (at approximately 90 seconds after the onset of irrigation). The inability to suppress nystagmus when a fixation target is provided is considered a pathological indication of central vestibular pathology.

Patient Instructions:

“I am going to put warm and cool air/water into each ear. I will begin by putting warm air in the right/left ear. The air/water will sound loud and will feel warm, but it should not be painful. If you experience pain, please tell me immediately. The air/water will be in your ear for approximately 60 seconds (30 for water). After 60 (30) seconds, I will take the air/water out of your ear and I will begin to ask you questions. I need two things from you: to keep your eyes open AT ALL TIMES – even if you are feeling “like you are in motion” - and focus on the questions that I am asking you to answer. Do you have any questions before we begin?” It is also helpful to reassure the patient that the sensation of motion is to be expected and will not last very long.

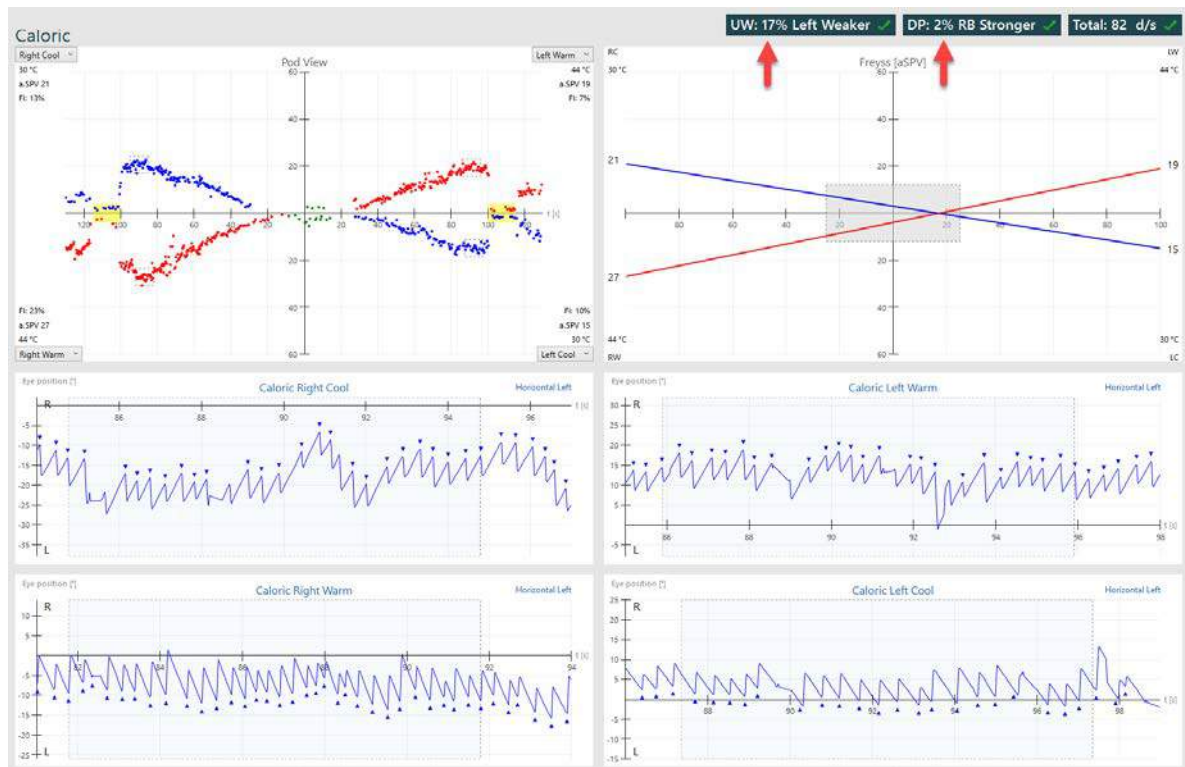
What to Expect:

A fully functional peripheral vestibular end organ will begin to respond to stimulation approximately 15-30 seconds into the irrigation procedure and will reach its peak approximately 60-90 seconds from the beginning of the irrigation process (air stimulus is used in the examples shown here). A rule of thumb is that warm air/water will produce nystagmus that beats *toward* the test ear and cool air/water will produce nystagmus that beats *away* from the test ear. (COWS – Cold Opposite, Warm Same). The nystagmus beats are represented by the dots plotted on the graph for each condition. The yellow bar represents the area of maximum performance. Each condition is giving a maximum Slow Phase Velocity (SPV) value and a Fixation Index value (FI). All 4 SPV values are added and a total SPV values is also displayed. The SPV values are used to calculate the overall weakness and to determine if any directional preponderance is present.

COMMON NORMATIVE VALUES FOR CALORIC RESPONSE PARAMETERS

PARAMETER:	LABELED AS:	COMMON NORM:
Unilateral Weakness	<i>UW%</i>	<25%
Directional Preponderance	<i>DP%</i>	<30%
Fixation Suppression	<i>FI%</i>	<50%
Bilateral Weakness	<i>Each ear total >11deg/sec</i>	
Hyperactivity	<i>Each ear total >140deg/sec</i>	

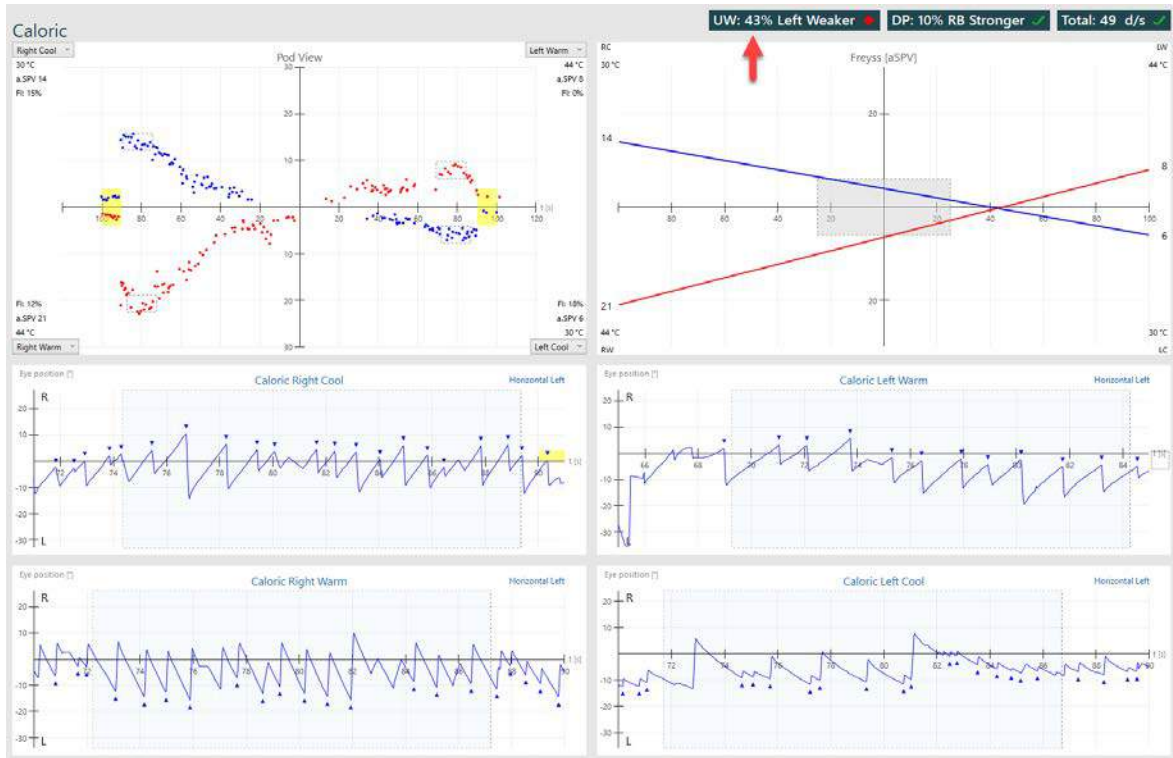
Threshold values for caloric testing, as referenced from Jacobson, GP, and Shepard, NT. Balance Functional Assessment and Management, 2nd Ed. San Diego; Plural Publishing, 2015



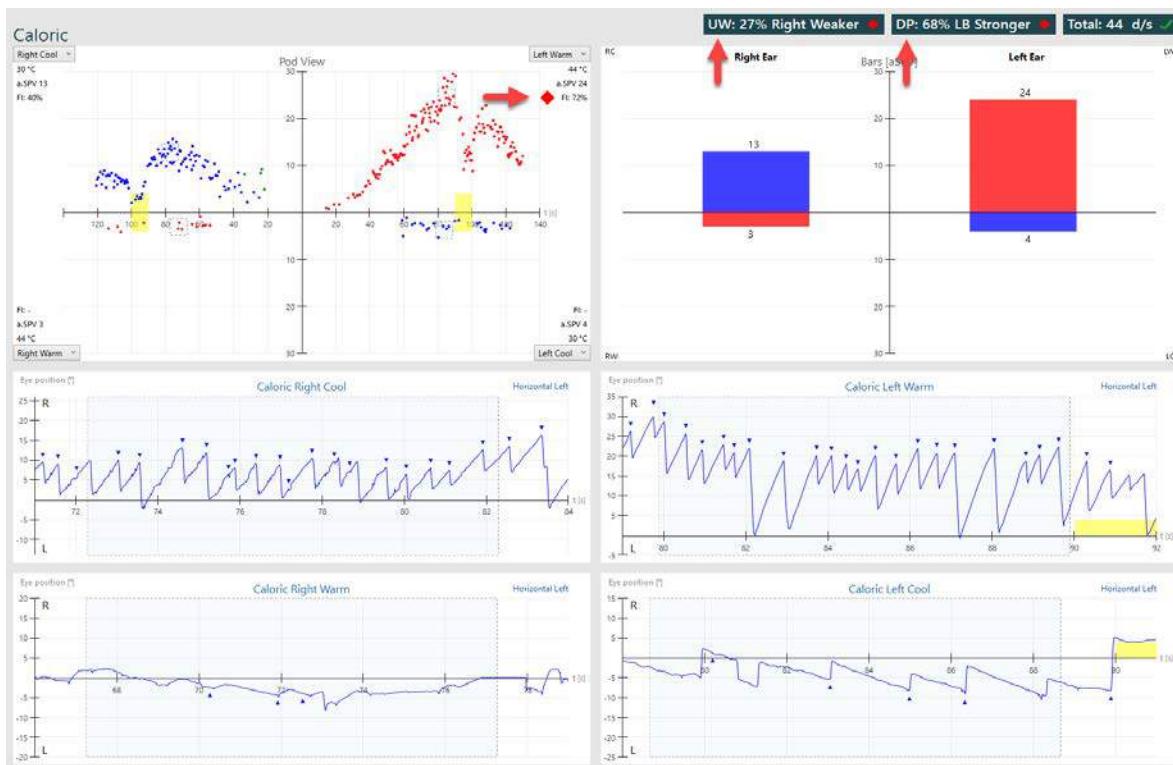
Caloric test showing normal response

Abnormal Test Results:

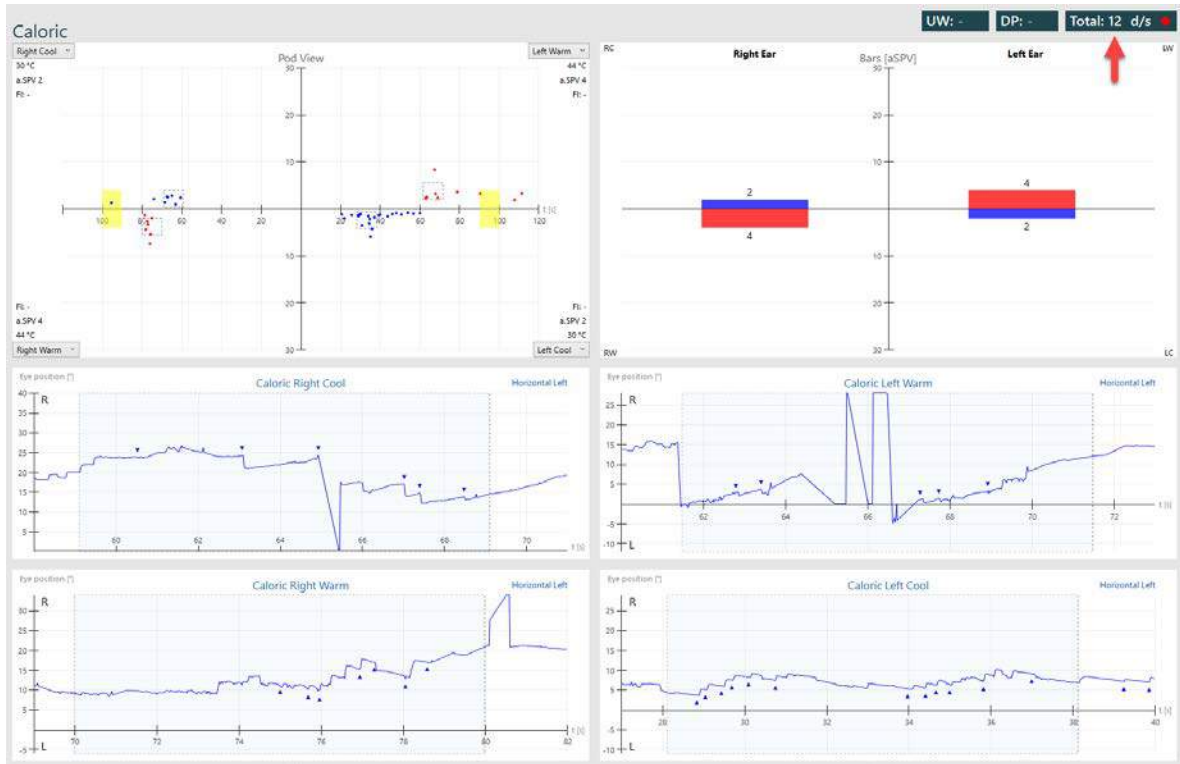
Abnormal caloric test results can present in several ways: as an asymmetry between ears (labeled as “unilateral weakness”), as “directional preponderance” (“directional preponderance” numerically expresses how the amount of right-beating nystagmus compares with the amount of left-beating nystagmus) or as a display of symmetrical, but weak, responses from both ears (labeled as “bilateral weakness”).



Caloric test showing a unilateral weakness (UW)



Caloric test showing a UW, a directional preponderance (DP), and an abnormal fixation value for L44°C



Caloric test showing a bilateral weakness (Please note: UW and DP will not be calculated when results present as a bilateral weakness)

Conclusion:

Caloric irrigation is the most valuable tool available to the healthcare field with which to assess vestibular function. It is the only test that allows for evaluation of each peripheral vestibular end organ *independently* of the other. Caloric irrigation gives the healthcare professional an assessment of whether the peripheral vestibular end organs are functioning symmetrically and/or whether the peripheral vestibular end organs are providing the brain with sufficient sensory information. For a complete discussion of differential diagnosis using caloric irrigation in VNG, refer to:

Jacobson, GP, and Shepard, NT. Balance Functional Assessment and Management, 2nd Ed. San Diego; Plural Publishing, 2015

*NOTE: This is intended only as a guide, official diagnosis should be deferred to the patient's physician.