

TRIOLOGICAL SOCIETY BEST PRACTICE

Is Vestibular Assessment Necessary or Valuable in Preoperative Evaluation for Cochlear Implantation?

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1 | Background

Patients who undergo cochlear implantation (CI) may experience short- or long-term vestibulopathy postoperatively. It has been theorized that those who have a shorter duration of symptoms may experience improvement secondary to central compensation, whereas those who have long-term symptoms may have bilateral vestibular hypofunction and decreased compensation [1]. Preoperative vestibular testing may be useful in the identification of unilateral or bilateral vestibular hypofunction, which has been associated with an increased likelihood of postoperative vertiginous symptoms [2]. However, vestibular testing is not routinely performed for all cochlear implantation candidates, and it is unclear whether this is useful as a screening measure. Therefore, the purpose of this summary is to describe whether there is a role for vestibular testing prior to cochlear implantation.

2 | Literature Review

West et al. performed a retrospective review of 409 pediatric and adult CI recipients, of whom video head impulse test (VHIT) was obtained in 94.1% and cervical vestibular evoked myogenic potential (cVEMP) in 84.1% of patients preoperatively [3]. Normal vestibular function was found in 73.6% of candidates, whereas vestibular hypofunction was identified in 15.2% of patients unilaterally and 10.5% of patients bilaterally. Implantation proceeded in all those with bilateral vestibulopathy, whereas in unilateral vestibulopathy, implantation of the hypofunctional

ear proceeded in 83.9% of patients. The decision for CI in the 14.5% of patients who had implantation in the functional ear was determined based on surgical and audiometric factors and patient choice. While this study did not correlate preoperative vestibular testing to postoperative symptoms or testing, the authors found that VHIT was more feasible to obtain preoperatively and may be more useful in decision-making compared to cVEMP. Furthermore, the study suggests that patient-specific screening for comorbid vestibular disorders may be more useful than a broad screening protocol and that vestibular assessment may be more applicable in determining whether patients should proceed with sequential CI or not.

Another retrospective cohort study by Nayak et al. of 149 adult patients who underwent CI and had preoperative videonystagmography (VNG) found that 30.9% and 21.5% of patients had unilateral and bilateral vestibular hypofunction, respectively [2]. Approximately 9.4% of patients of the cohort had postoperative vestibular symptoms lasting more than 1 month, and a significantly higher proportion of patients with postoperative symptoms had abnormal preoperative VNG (78.6% vs. 49.6%, $p=0.0497$). CI was performed in the hypofunctional ear in 67.4% and in the contralateral ear in 32.6% of the sample, with no significant difference in postoperative vestibular symptoms identified between these groups. A significantly higher proportion of patients with postoperative symptoms had a history of Meniere's disease (35.7% vs. 8.1%, $p=0.006$), although it is not clear whether symptoms were worse postoperatively or represented patient baseline. Of note, the mean age of the cohort was relatively older (74.4 years), and the authors suggest that this

may be why a relatively high proportion of abnormal vestibular testing was found.

Lovin et al. further examined the use of vestibular screening in older cochlear implant candidates through a case control study of 33 primary CI candidates aged 60–80 years old who all underwent preoperative VNG, including cVEMP, caloric stimulation, and/or rotary chair testing, and were compared to 184 controls [1]. A significantly higher proportion of CI candidates demonstrated abnormal cVEMP testing (72.4% vs. 40.0%, $p=0.002$), abnormal caloric testing (66.6% vs. 39.9%, $p=0.007$), and rotary chair reduced gain (33.3% vs. 4.0%, $p<0.001$). Twenty-seven of the CI candidates underwent implantation and the results of vestibular testing determined the side of implantation in four patients, of which one patient deferred bilateral implantation due to concerns about bilateral vestibulopathy and another experienced postoperative dizziness that was treated with vestibular rehabilitation. The authors suggest that the higher rates of unilateral and bilateral vestibular hypofunction as well as incomplete vestibular compensation indicate that audiometric benefit and vestibular dysfunction should be weighed in elderly CI candidates. Furthermore, given that VNG results impacted choice of the implanted ear in 15% of cases, preoperative VNG was suggested to be useful as a risk stratification measure when discussing postoperative vestibular dysfunction.

An important aspect to consider is the feasibility of vestibular screening; while two of the aforementioned studies did implement a broad screening protocol, this may be difficult to implement in every center. To this end, Jiam et al. utilized the clinical head impulse test (cHIT) for all 64 CI candidates in their study, of which 9 candidates were referred for more formal vestibular testing based on cHIT results [4]. Eight of these patients had abnormal video head impulse testing and six had abnormal caloric testing. Of note, 43.75% of candidates endorsed vestibular symptoms whereas only 42.9% of these patients demonstrated abnormal cHIT; in contrast, 32.4% of patients with abnormal cHIT testing had no reported vestibular symptoms. Postoperative cHIT was utilized for those planning subsequent contralateral implantation. While the sensitivity and specificity of cHIT is variable depending on the examiner and degree of vestibular hypofunction, the study did find utility in the test to quickly assess vestibular symptoms and identify patients who may benefit from more formal testing.

Another retrospective cohort of CI candidates by Reeder et al. found that a hearing threshold of 60 dB or worse at 250 Hz was the best prognostic indicator for bilateral vestibular hypofunction and suggested that patients who met this criterion may benefit from vestibular testing prior to implantation [5]. VNG was obtained for all 180 CI candidates preoperatively, with 39.4% demonstrating evidence of any vestibular hypofunction, with or without symptoms; 26.8% of these patients had bilateral hypofunction. Those with bilateral hypofunction had significantly higher mean audiometric thresholds of 250 Hz (88.5 dB vs. 77.0 dB vs. 64.4 dB, $p<0.001$) and 1000 Hz (97.9 dB vs. 87.0 dB vs. 83.6 dB, $p=0.024$) compared to with unilateral weakness and normal hearing. This study was limited in its lack of postoperative symptom data, but does suggest an audiometric criterion that may be useful in determining which patients may benefit from vestibular testing.

3 | Best Practice Summary

Preoperative vestibular testing may have a role in identifying CI candidates with bilateral vestibular hypofunction, who are theorized to have a higher risk of postoperative vestibular symptoms secondary to decreased central compensation, and can help with decision-making in cases of bilateral candidacy and subsequent implantation. However, while both broad vestibular screening and specific criteria protocols have been suggested, there is still relatively limited data on the clinical implications of vestibular testing and how screening protocols may be achieved in a feasible manner.

4 | Level of Evidence

These recommendations are based on two retrospective cohort studies (Level II), one case control (Level III), and two case series (Level III).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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