

How to Cite:

Alraies, A. A. ., & Ghanaim, M. M. (2023). Ocular lateral deviation as a vestibular sign to improve detection of posterior circulation stroke. *International Journal of Health Sciences*, 7(S1), 1954–1961. <https://doi.org/10.53730/ijhs.v7nS1.14436>

Ocular lateral deviation as a vestibular sign to improve detection of posterior circulation stroke

Amr Abdulwarth Alraies

Corresponding author email: amralraies@hotmail.com

Mahmood Mohammed Ghanaim

Email: mmghanaim@dha.gov.ae

Abstract---Posterior circulation is affected by approximately twenty-five percent of all strokes, & many studied cases visit emergency rooms diagnosis is frequently difficult because studied cases frequently appear with variety of symptoms and frequently minimal clinical indicators. Chronic nystagmus, nausea, vomiting, head motion intolerance, & poor balance are all symptoms of acute vestibular syndrome, which is prevalent condition with significant number of cerebrovascular causes. Studied cases with AICA strokes have positive head impulse test, although nystagmus frequently reverses direction, & big amplitude skew have been useful on central localization. If HINTS has been peripheral, possibility of posterior circulation stroke has been unlikely. Therefore, it is necessary to look at any single triad component that points to central HINT. Peripheral HINTS avoid needless medical resource waste by not requiring emergency MRI or angiography tests.

Keywords---ocular lateral, vestibular sign, circulation stroke, detection of posterior.

Introduction

Posterior circulation is affected by approximately twenty-five percent of all strokes, & many studied cases visit emergency rooms diagnosis is frequently difficult because studied cases frequently appear with variety of symptoms and frequently minimal clinical indicators. Chronic nystagmus, nausea, vomiting, head motion intolerance, & poor balance are all symptoms of acute vestibular syndrome, which is prevalent condition with significant number of cerebrovascular causes. In these studied cases, up to thirty five percent of strokes may go unnoticed, & initial examination that fails to detect cerebellar stroke is linked to eight-fold increased risk of mortality. Rapid detection is necessary for

reperfusion therapeutic options, & secondary prevention is crucial because POCS sequelae & repeat stroke have been both reported to be as common as strokes affecting anterior circulation. Consequently, clinical technique is required to identify acute POCS in AVS **(1)**.

National Institutes of Health Stroke Scale does not list dizziness or vertigo as symptom of stroke or transient ischaemic attack, & Face Arm & Speech test has not been sensitive for posterior circulation ischaemia. Although extensively utilised, computed tomography scans can miss up to sixty percent of early posterior circulation ischaemia. Although cerebral magnetic resonance imaging has been said to be more sensitive, numerous hospitals might not have immediate access to it. When any of 3 oculomotor signs—normal horizontal head impulse, gaze-direction nystagmus, or skew deviation—appear, Head Impulse-Nystagmus-Test of Skew test may be carried out at patient's bedside to rule out central cause, such as stroke in AVS. We conducted systematic evaluation to assess HINTS' efficacy in detecting POCS in AVS **(2)**.

HINTS may be used at bedside & are rapid & non-intrusive test is underutilised in emergency situations despite being based on well-established neuroscientific notions head-impulse component investigates interactions among brainstem & vestibular circuits existence of direction-changing nystagmus shows harm to cerebellum & brainstem's gaze circuits, & skew deviation of eyes reveals damage to brainstem's central otolithic connections. Evidence supports better yield in strokes containing posterior inferior cerebellar artery stroke compared to anterior inferior cerebellar artery, while we had been unable to evaluate sensitivity of HINTS for each vascular area **(3)**.

Utilising HINTS has its own drawbacks, including fact that it can be challenging for studied cases who are ill, unwell, have severe functional disabilities, or are under influence of drugs or alcohol positive HINTS may point to alternative central causes of AVS, despite test's value in detecting strokes. Nystagmus that subsides with visual fixation or successful Dix-Hallpike procedure may be sign of vestibular disease. It is proposed that Frenzel's glasses, ophthalmoscopy, video nystagmography, Doppler ultrasonography, & brain perfusion scans could increase predictive value for stroke diagnosis, however these techniques need to be validated in further research **(4)**.

2 studies in this evaluation classified individuals with "early" normal MRI results as peripheral AVS, which may not have been appropriate. Up to fifty percent of lacunar infarctions could be overlooked within forty-eight hours after the beginning of symptoms, suggesting that early MRI cannot be sensitive in acute POCS. It is possible that structural alterations seen on MRI images occur later than clinical signs of brain dysfunction. Small infarcts could result in diminished blood flow that is just enough to elicit symptoms but not enough to alter MRI **(5)**.

Even though temporary or persistent solitary vertigo or dizziness are frequent symptoms of POCS, such individuals are omitted from randomized controlled studies designs & diagnostic standards of research that were part of this review vary. Considering that POCS accounts for twenty five percent of all strokes, the number of patients was minimal. The issue of generalizability is brought up

by fact that studied cases had been carefully chosen & assessed in single center by seasoned neurologists. In 4 of studies included in this analysis, studied cases were referred from emergency room due to questionable diagnosis, existence of vascular risk factors, or inability to ameliorate symptoms. As studied cases with small strokes or those without vascular risk factors can be dismissed without further assessment, this can reflect selection bias **(6)**.

Vertigo, nausea, & unsteadiness of gait are symptoms of acute vestibular syndrome, which also includes head-motion intolerance & nystagmus that lasts for days to weeks. These symptoms appear suddenly (over a period of seconds to hours). Acute peripheral vestibulopathy, often known as vestibular neuritis or labyrinthitis, is a group of symptoms that frequently have self-limited, presumed-viral aetiology. Nearly 150 000 of 2.6 million visitors to emergency rooms in US due to dizziness or vertigo each year had APV diagnosis.¹ Some studied cases with AVS, nevertheless, can have potentially fatal brainstem or cerebellar strokes that resemble APV. Acute vestibular syndrome presentations to emergency room may signify posterior circulation infarctions in $\geq$ twenty-five percent of cases, according to small observational studies. Especially in posterior fossa, CT scans have limited sensitivity (around sixteen percent) for acute infarction, & brain MRI is not always accessible. Additionally, studies indicate that acute vertebrobasilar strokes may result in false-negative MRI results. To recognize studied cases with acute central vestibulopathies, bedside predictors are crucial **(2)**.

Less than half of AVS presentations show limb ataxia, dysarthria, or other evident neurological characteristics, despite fact that conventional training advises focusing on long-tract or frank cerebellar indications sole tool available at bedside to diagnose vertebrobasilar stroke in these studied cases can be careful eye movement evaluation. A horizontal head impulse test assessing vestibulo-ocular reflex function appears to be the most reliable bedside predictor of pseudolabyrinthine stroke in AVS. Halmagyi & Curthoys initially described this examination as bedside examination for peripheral vestibular disorder in 1988. To definitively differentiate APV from stroke in studied cases with AVS, h-HIT should be employed. While aberrant VOR is poorer predictor of peripheral localization, normal VOR by h-HIT strongly implies central localization fact that some studied cases with aberrant h-HIT (implying APV) have lateral pontine strokes reduces sign's diagnostic utility **(6)**.

Nystagmus, that changes direction on eccentric gaze, is another bedside predictor of central disease in acute vestibular syndrome characteristic, predominately horizontal nystagmus that beats only in 1 direction & intensifies as studied case looks in direction of nystagmus fast phase should typically be present in AVS patients. However, most strokes that show AVS picture have nystagmus with primarily horizontal vector that mimics APV. Vertical or torsional nystagmus in this clinical context has been strong marker of central pathology. Sometimes, shift in direction on eccentric gaze separates nystagmus typical of central AVS from APV **(7)**.

Skew deviation is the 3rd bedside indicator of central pathology. Skew deviation has been right-to-left imbalance of vestibular tone (i.e., neuronal firing), especially otolithic inputs, to oculomotor system that manifests as vertical ocular

misalignment modest clinical trio of skew deviation, head tilt, & ocular counterroll sometimes includes it as part of abnormal ocular tilt reaction. Alternate cover testing, with or without quantified prismatic correction, is typically used to identify skew. Skew (with or without complete ocular tilt reaction) was primarily found as central sign in studied cases with posterior fossa pathology, although being described in studied cases with vestibular peripheral illnesses. It is described as herald manifestation of basilar occlusion & is most frequently observed with brainstem strokes. Skew deviation may be specific indicator of central disease in individuals with AVS, according to recent retrospective case-control research comparing oculomotor characteristics between those with vestibular neuritis (i.e., APV) and those with "vestibular pseudoneuritis" (most brought on by stroke) **(8)**.

It is not unexpected that skew deviation & brainstem stroke are related. While cases of primary-position skew with peripheral vestibular disease are documented & some studied cases with bilateral cerebellopathy experience alternating skew deviation in lateral gaze, lesions causing skew & pathological ocular tilt reaction to most frequently discovered in brainstem. In individuals with central AVS mimicking APV, our prospective results add to earlier retrospective research that suggested substantial correlation among mild oculomotor symptoms & stroke. Even though normal h-HIT remains strongest bedside predictor of stroke & that its test characteristics have been like early MRI DWI, about 1 in 10 strokes will still go undiagnosed if other results have not been considered. We have found 2 additional minor results that must enhance bedside stroke identification without significantly reducing specificity **(9)**.

Our research provides more proof that caution must be exercised when using DWI alone to rule out stroke in AVS in initial twenty-four to forty-eight hours following symptom onset, despite fact that doctors are increasingly relying on MRI DWI for acute stroke diagnosis. sensitivity of DWI in our series had been eighty eight percent overall & seventy two percent for lateral medullary & lateral pontine infarctions, localizations that are highly common between vertebrobasilar strokes that closely resemble APV. These estimates confirm findings of two earlier studies on early DWI, which included 206 vertebrobasilar stroke cases & discovered seventy seven percent sensitivity in 24 hours of onset of symptoms **(10)**.

It seems common, happening in maybe thirty-five percent of cases, for posterior circulation strokes to be initially misdiagnosed when they present with vertigo. Given that fifty-eight percent of studied cases in our series either lacked evident symptoms or had just isolated, severe truncal ataxia, high rate of misdiagnosis cannot be shocking. Useless reliance on CT to rule out stroke most likely makes things worse. 1 short series of missed cerebellar infarctions indicates that forty percent of patients experience negative results, illustrating seriousness of such misdiagnoses. In younger individuals who have not been often thought to be at risk for stroke, misdiagnosis can be more common. APV mimic may be symptom of vertebral artery dissections, main diagnosable reason for posterior circulation stroke in young adults. Fifteen of our strokes studied cases had been under fifty years old, & three of them had dissections, we discovered. **(11)**.

While emergency physicians, internists, and even general neurologists are not familiar with bedside methods for HINTS examination, those without subspecialty training in neuro-otology may still interpret subtle oculomotor results of this type with accuracy, indicating that training in use of these methods can be possible. 3 HINTS tests—h-HIT of VOR function, observation for nystagmus in primary, right, & left gaze, & alternate cover test for skew deviation—may be completed at bedside in about minute, as opposed to five to ten minutes or more required for more thorough, traditional neurological examination. Acute MRI brain with DWI often costs over \$1000 & requires at least five to ten minutes of scan time in addition to wait time of many hours to various days. This bedside procedure might provide a rapid, affordable alternative to existing practice in era where efficiency & cost containment have been priorities. Our data indicate that this approach may be able to replace thorough neurological testing & neuroimaging in frontline healthcare settings under time constraints without sacrificing diagnosis accuracy, even though additional confirmatory studies in wider variety of acute vestibular studied cases have been required **(12)**.

We noted number of potential restrictions on the results of our investigation partially unmasked examiner & selective MRI follow-up scans are threats to internal validity. As previously mentioned, study examiner (J.C.K.) had been blinded to imaging findings but had not been blinded to patient's clinical history, outcomes of general neurological examination, or any overt oculomotor signals when looking for more subtle eye signs sensitivity of these indicators may have been artificially increased by observer bias in interpretation of modest eye results, but this seems implausible for thirty three percent of cases in which apparent neurological abnormalities had been lacking. Only a few instances, based on the emergence of novel neurological symptoms or unusually modest oculomotor symptoms, underwent MRI follow-up scans. HINTS battery's apparent sensitivity may have increased as result of some strokes being mistakenly classified as APV due to this selective retesting. But after being monitored, none of these APV studied cases experienced any acute neurological impairments or strokes **(13)**.

The generalizability of the examination method & sampling from high-risk subpopulations are threats to external validity. It is unknown if clinical results could be repeated by additional examiners since studied cases had been only evaluated by one examiner increasing body of research on these modest eye indicators from numerous researchers supports reproducibility, at least between field subspecialists. We only allowed high-risk AVS studied cases with at least 1 stroke risk factor & no prior history of recurrent vertigo to register in the study. We picked this strategy since there weren't enough money to image all the low-risk studied cases in whom MRI couldn't be scientifically justified. This selection produced individuals with APV who may be atypical (ninety two percent with leukoaraiosis) & significantly enriched cerebrovascular cohort (seventy six percent central, seventy-three percent cerebrovascular, & sixty-nine percent ischemic stroke) **(14)**.

Acute vertigo is a relatively prevalent clinical symptom, occurring between five & ten percent of the time in neurology clinics & 6.7 percent of the time in hospitalised patients. To avoid missing optimum window for thrombolysis or

mechanical thrombectomy, neurologists & emergency physicians must quickly distinguish among vertigo caused by peripheral vestibular end-organ disorders (like vestibular neuritis) & vertigo caused by central nervous system disorders (like cerebellar stroke). According to several multicenter studies, between 3.2 and 12.5 percent of all emergency room studied cases experience central vertigo **(15)**.

Acute Vestibular Syndrome has been group of clinical syndromes that are characterised by persistent vertigo or dizziness with abrupt start that can last for few days to few weeks & has been linked to progressive vestibular system impairment occurrence of persistent vertigo for longer than twenty-four hours is required by canonical standard for AVS diagnosis symptoms of AVS may be significantly reduced by new treatment options such intravenous thrombolysis & interventional therapy, but it's crucial to make prompt diagnosis in 4.5 to 6 hours of onset. In 2014, International Panel on Classification of Vestibular Symptoms recommended classifying AVS into broad categories (lasting more than six hours) & narrow categories (lasting more than twenty-four hours) based on length of symptoms **(16)**.

Diagnosis of AVS frequently involves use of CT (Computed Tomography) & MRI (Magnetic Resonance Imaging), yet CT has poor sensitivity for early stroke, & missed diagnosis rate might reach sixty percent. Use of MRI for emergency examinations is typically not permitted, which limits availability of MRI diagnostics in emergency rooms. Furthermore, prior research has demonstrated that MRI has limited sensitivity for diagnosis of posterior circulation ischemic stroke. Another study found that between twenty percent and thirty-five percent of MRIs for central vertigo fail to diagnose condition. Additionally, missed cerebellar infarction diagnosis may be linked to an eightfold greater chance of dying **(17)**.

HINTS's clinical utility in diagnosis of AVS (head impulse-nystagmus-skew test). With sensitivity of one hundred percent & specificity of 90–94.4 percent, studies have shown that HINTS are more sensitive than neuroimaging methods in separating stroke from AVS in studied cases. 3 components make up the HINTS examination: the HIT examination, spontaneous nystagmus (Nystagmus), and ocular deviation (Test of Skew). According to recent studies, studied cases may use HINTS to correctly differentiate among AVS & other central/peripheral neurological illnesses. For instance, diagnosis of central AVS may be made using any positive result in any of negative HIT, central type nystagmus, conjugate ocular torsion, & aberrant vertical smooth tracking, with sensitivity of one hundred percent & specificity of ninety percent in separating central AVS from stroke. Though HINTS appears to be an available tool for diagnosing AVS, its protocols & criteria must be improved for optimum practical applicability **(18)**.

Early detection of potential posterior circulation stroke requires early differentiation among central & peripheral AVS. For hemorrhagic lesions, CT is sensitive, but not for ischemic lesions. MRI examination access is generally limited, even though DWI of MRI may detect early ischemia lesions. Moreover, forty-eight hours after beginning of symptoms of minor posterior circulation cerebral infarction, false-negative rate of MRI diffusion-weighted imaging may still

be as high as twelve percent. Frontline emergency physicians have adopted the HINTS test, which had been created by neuro-ophthalmologists as bedside diagnostic to rule out central reasons for vertigo in studied cases with AVS (19).

With combined sensitivity of 95.5 percent & specificity of 71.2 percent when used for any stroke, studied cases with positive HINTS test had 15-fold higher chance of getting POCS than those with negative HINTS test. Overall, there had been 59.9 percent positive predictive value & 97.2 percent negative predictive value. Similar test results, but with higher specificity & lower sensitivity. Studied cases with AICA strokes have positive head impulse test, although nystagmus frequently reverses direction, & big amplitude skew have been useful on central localization. If HINTS has been peripheral, possibility of posterior circulation stroke has been unlikely. Therefore, it is necessary to look at any single triad component that points to central HINT. Peripheral HINTS avoid needless medical resource waste by not requiring emergency MRI or angiography tests (15).

References

1. Platti, N., Fakih, R., Maley, J., Deniz, K., Agac, B., Fattal, D. (2022). Ocular lateral deviation as a vestibular clinical sign of medial posterior inferior cerebellar artery strokes: A case report. *Journal of Stroke and Cerebrovascular Diseases*, 31(8), 106618.
2. Kattah, J. C., Badihian, S., Pula, J. H., Tarnutzer, A. A., Newman-Toker, D. E., Zee, D. S. (2020). Ocular lateral deviation with brief removal of visual fixation differentiates central from peripheral vestibular syndrome. *Journal of neurology*, 267, 3763-3772.
3. Mantokoudis, G., Gold, D. R., Newman-Toker, D. E. (2019). Video-oculography in the emergency department: an “ecg” for the eyes in the acute vestibular syndrome. *Advances in translational neuroscience of eye movement disorders*, 283-307.
4. Pawar, V., Anand, A., Kulkarni, P., Kim, J. S. (2021). A new ocular motor sign in acute vestibular syndrome: Is HINTS plus enough?. *Neurology Asia*, 26(4).
5. Calic, Z., Nham, B., Bradshaw, A. P., Young, A. S., Bhaskar, S., D'Souza, M., et al. (2020). Separating posterior-circulation stroke from vestibular neuritis with quantitative vestibular testing. *Clinical Neurophysiology*, 131(8), 2047-2055.
6. Krishnan, K., Bassilious, K., Eriksen, E., Bath, P. M., Sprigg, N., Brækken, S. K., et al. (2019). Posterior circulation stroke diagnosis using HINTS in patients presenting with acute vestibular syndrome: a systematic review. *European Stroke Journal*, 4(3), 233-239.
7. Machner, B., Choi, J. H., Neumann, A., Trillenber, P., Helmchen, C. (2021). What guides decision-making on intravenous thrombolysis in acute vestibular syndrome and suspected ischemic stroke in the posterior circulation?. *Journal of Neurology*, 268(1), 249-264.
8. Calic, Z., Nham, B., Bradshaw, A. P., Young, A. S., Bhaskar, S., D'Souza, M., et al. (2020). Separating posterior-circulation stroke from vestibular neuritis with quantitative vestibular testing. *Clinical Neurophysiology*, 131(8), 2047-2055.

9. Zürcher, E., Richoz, B., Faouzi, M., Michel, P. (2019). Differences in ischemic anterior and posterior circulation strokes: a clinico-radiological and outcome analysis. *Journal of Stroke and Cerebrovascular Diseases*, 28(3), 710-718.
10. Machner, B., Erber, K., Choi, J. H., Trillenber, P., Sprenger, A., Helmchen, C. (2021). Usability of the head impulse test in routine clinical practice in the emergency department to differentiate vestibular neuritis from stroke. *European Journal of Neurology*, 28(5), 1737-1744.
11. Dornák, T., Král, M., Šaňák, D., Kaňovský, P. (2019). Intravenous thrombolysis in posterior circulation stroke. *Frontiers in Neurology*, 10, 417.
12. Xun, K., Mo, J., Ruan, S., Dai, J., Zhang, W., Lv, Y., et al. (2021). A meta-analysis of prognostic factors in patients with posterior circulation stroke after mechanical thrombectomy. *Cerebrovascular Diseases*, 50(2), 185-199.
13. Pirson, F. A. V., Boodt, N., Brouwer, J., Bruggeman, A. A., den Hartog, S. J., Goldhoorn, R. J. B., et al. (2022). Endovascular treatment for posterior circulation stroke in routine clinical practice: results of the multicenter randomized clinical trial of endovascular treatment for acute ischemic stroke in the Netherlands registry. *Stroke*, 53(3), 758-768.
14. Choi, J. H., Oh, E. H., Park, M. G., Baik, S. K., Cho, H. J., Choi, S. Y., et al. (2018). Early MRI-negative posterior circulation stroke presenting as acute dizziness. *Journal of Neurology*, 265, 2993-3000.
15. Alawieh, A. M., Eid, M., Anadani, M., Sattur, M., Maier, I. L., Feng, W., ... et al. (2020). Thrombectomy technique predicts outcome in posterior circulation stroke—insights from the STAR collaboration. *Neurosurgery*, 87(5), 982-991.
16. Zürcher, E., Richoz, B., Faouzi, M., Michel, P. (2019). Differences in ischemic anterior and posterior circulation strokes: a clinico-radiological and outcome analysis. *Journal of Stroke and Cerebrovascular Diseases*, 28(3), 710-718.
17. Lee, S. H., Han, J. H., Jung, I., Jung, J. M. (2020). Do thrombolysis outcomes differ between anterior circulation stroke and posterior circulation stroke? A systematic review and meta-analysis. *International Journal of Stroke*, 15(8), 849-857.
18. Weber, R., Minnerup, J., Nordmeyer, H., Eyding, J., Krogias, C., Hadisurya, J., et al. (2019). Thrombectomy in posterior circulation stroke: differences in procedures and outcome compared to anterior circulation stroke in the prospective multicentre REVASK registry. *European journal of neurology*, 26(2), 299-305.
19. Luo, G., Mo, D., Tong, X., Liebeskind, D. S., Song, L., Ma, N., et al. (2018). Factors associated with 90-day outcomes of patients with acute posterior circulation stroke treated by mechanical thrombectomy. *World neurosurgery*, 109, e318-e328.