CDP as a Diagnostic Tool for the Evaluation of Vestibular Migraines

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Introduction

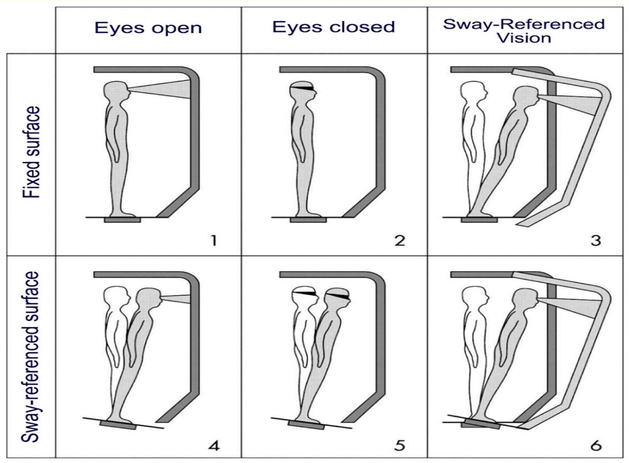
Vestibular Migraines (VM) are a collection of vestibulopathies (dizziness, vertigo, motion sensitivity) with or without migraines. VM accounts for up to 1% of illness in the American population, and specifically in migraines/headache clinics account for 9-11% of presenting patients.[1,2] We speculate that the true number however is underdiagnosed which is demonstrated by a study discovering that primary care physicians referring to an academic medical center suspected roughly 2% of patients of having VM, whereas 20% of all referred patients were diagnosed.[5] Patients may go for years undiagnosed because of VM's variable presentation or misdiagnosed because of similar conditions like Meniere Syndrome or BPPV which often presents alongside vestibular migraines.[3] These comorbid conditions obscure vestibular testing and neurotologic exams and contribute to patient frustration.

Currently evaluation consists of a thorough HPI as there are no clinical pearls, imaging studies, or diagnostic tests consistent with vestibular migraines during or in-between spells. Clinical diagnosis depends on experience of the provider, exclusion of differential diagnosis, and the use of widely accepted international guidelines such as the ICHD-3b[2], published by the collaboration of the Barany Society and the International Headache Society. Current literature has failed to investigate data from CDP studies which we argue may be a way to make existing workup protocol more diagnostically useful.

Methodology

The data (est. 3,500 patients) was extracted from a windows XP version of NeuroCom running on a virtual machine of the same operating system. Screenshots of patient's test results were taken and ran through an opensource image processor to generate corresponding excel tables. Any errors were corrected and then transferred to a master excel file which lists patients by MRN, age, gender, diagnosis, and test results for SOT and MCT. The following figures consist of 100 people, 50 with vestibular migraines and 50 with vestibular schwannomas (VS). VS patients were chosen as a control comparison group because they had an isolated peripheral pathology causing their imbalance and a predictable SOT outcome.

SOT Procedure



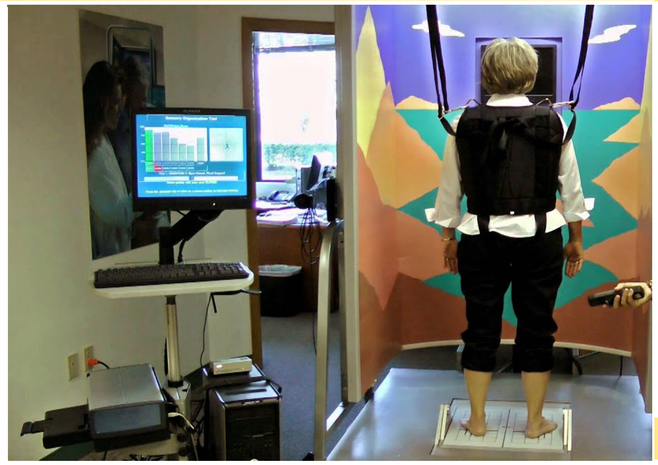


Figure 1: Conditions 1-6 on the SOT protocol: There are 6 conditions, each with 3 trials lasting 20 sec. During the 1st and 2nd condition, the patient stands still with eyes open and closed, respectively. This tests the patient's ability to maintain balance without visual cues, measuring sway changes and the use of somatosensory input. In Condition 3, the patient remains standing with their eyes open, however the visual background sways, giving a false visual stimulus. In Condition 4, somatosensory cues are inaccurate by swaying the support surface. Condition 5 maintains eyes closed and a swaying of the support surface. Condition 6, both the visual background and support surface are swayed.

Comparison between Vestibular Migraines and Vestibular Schwannoma

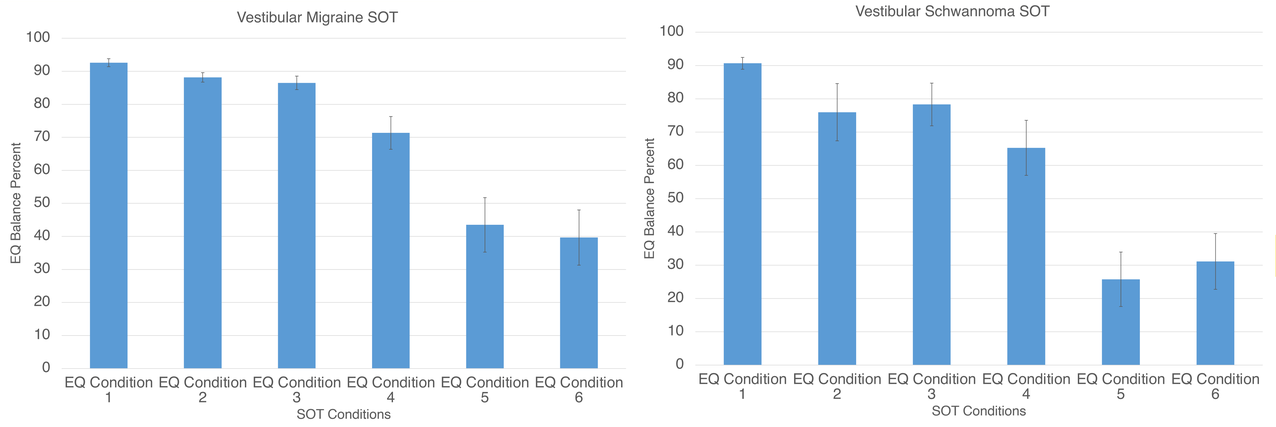


Figure 2: Equilibrium test results for patients with vestibular migraines and vestibular schwannoma are shown. The horizontal axis describes the 6 conditions as described above. The vertical axis describes balance percent during the equilibrium tests. 100% would indicate perfect balance and 0 would indicate no balance or a fall. Standard error bars are 2SE and assume that a FALL is marked as 0 (no balance) for both test parameters. Understandably this will increase the standard error range.

EQ Condition	Vestibular Migraine mean (std)	Vestibular Schwannoma mean (std)	P-value
1	92.61 (3.62)	90.64 (5.41)	p<0.05
2	88.15 (4.48)	75.97 (26.85)	p<0.01
3	86.50 (6.46)	78.29 (20.52)	p<0.05
4	71.34 (16.46)	65.26 (26.79)	NS
5	43.5 (23.37)	25.77 (27.43)	p<0.01
6	39.65 (27.72)	31.13 (27.49)	NS

Table 1: Describes the mean and standard deviation by equilibrium condition for comparison between VM and VS patients. The P-value column describes significance, where the listed p-value is the level of significance and NS stands for no significance.

Results

Overall VS patients have the greatest fall rate, the earliest increase in fall rate, are "vision dependent" balancers, and always have a high impairment of somatosensory cues. Vestibular migraine patients are not "vision dependent" and maintain a consistent level of balance until there is a significant change in somatosensory cues. They can be termed "somatosensory sensitive." Both groups have a predictable ankle preference for balance until the most difficult conditions (5 and 6) where they begin using their hips. These conditions also have a corresponding increase in falls for both groups.

Conclusion

The figures presented today show only a small glimpse into the complexity of the data set. It would be unrealistic and inefficient to manually compare different combinations of test results and demographic features of patients to establish a trend or diagnostic pattern. The plan is to run the complete data set in a machine learning algorithm. We hope that with this larger pool, an artificial learning program will be able to find patterns in the data that we currently understand and ones that we haven't found. This will be done with a cycle of training, testing, collecting feedback, and using the feedback for future training.

Future Studies

- Machine learning algorithms for data interpretation
- Including other common conditions that undergo CDP testing (Meniere, BPPV, stroke)
- Age adjusted data sets
- Comparing SOT and MCT test results

Acknowledgements

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