International Journal of Otorhinolaryngology and Head and Neck Surgery
Meenakshi S et al. Int J Otorhinolaryngol Head Neck Surg. 2019 May;5(3):587-592
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20191516

Correlation between clinical diagnosis and claussens butterfly chart patterns in patients with vertigo

Sunderaswaran Meenakshi[1], Mohankumar Venugopal[2]*, Mcdonald Choultry Rajasekar[1]

Department of Otorhinolaryngology, [1]Sree Balaji Medical College and Hospital, Madras Medical College, [2]Rajiv Gandhi Govt General Hospital, Chennai, Tamil Nadu, India

Received: 19 March 2019
Revised: 04 April 2019
Accepted: 05 April 2019

***Correspondence:**
Dr. Mohankumar Venugopal,
E-mail: itsmee19@gmail.com

ABSTRACT

Background: Neurotology forms the grey area between otologists and neurologists. Vertigo is also a complex symptom that often has multiple pathologies leading to the presentation. Electronystagmography is a complex investigation that cannot be comprehended by many other doctors. The Claussens butterfly chart offers a simple pictoral representation of the caloric test that can be easily and immediately Understood by patients and other doctors.
Methods: 50 patients presenting to the Neurotology OPD with complaints of vertigo were subjected to this investigation and the butterfly chart derived. The correlation between the clinical diagnosis and the butterfly chart patterns studied.
Results: The sensitivity and specificity of the butterfly code for central lesions is 75% and 73% respectively. The sensitivity and specificity of the butterfly code for peripheral lesions is 64.3% and 50% respectively.
Conclusions: The butterfly chart is a very simple and useful investigation that can help classify the etiology of vertigo as central or peripheral and thus help in treatment. It is also the only investigation that is helpful to localize the side of lesion in vertigo of any etiology.

Keywords: Butterfly chart, Electronystagmography, Vertigo

INTRODUCTION

The word "Vertigo" is derived from the Latin word "vertere" which means "to turn". The international classification of diseases defines vertigo as a feeling of movement, a sensation as if the external world were revolving around the patient (objective vertigo) or as if he himself were revolving in space (subjective vertigo).

Vertigo is the tenth most common reason for referrals to neurophysicians.[1] It is one of the most under diagnosed symptomatology – 80% of patients had no diagnosis reached and the most misdiagnosed condition.[1,2] It forms 10% - of total cases in some centres, with a lifetime prevalence of 30%.[2,3] Although in 90% of these cases a clinical diagnosis can be made by an experienced doctor even without imaging/ laboratory techniques.[1]

The electronystagmography (ENG) is an important tool for the Neurotologist to help arrive at a diagnosis, to locate the side of lesion and also classify the lesion as peripheral or central.

However the ENG is also a bit complicated to understand for majority of doctors. The butterfly code/ chart however provides a simple version of understanding the ENG findings and also arriving at the diagnosis.

Aims and objectives of this study

- To study the clinical presentations of vertigo and arrive at a clinical diagnosis of etiology.
- To use the electronystagmography (butterfly chart) to verify the diagnosis (central or peripheral vertigo and side of lesion).
- To compare the electronystagmography (butterfly chart) findings with the clinical diagnosis of cause of vertigo.

METHODS

This study was conducted in the Neurotology OPD of Sree Balaji Medical College, Chrompet on patients complaining of giddiness presenting between December 2017 – December 2018. 50 patients were selected as per inclusion and exclusion criteria.

Inclusion criteria

Patients aged 18–65 yrs with complaints of Rotation/ instability/ dizziness. Patients with clinical symptoms of rotation/ instability/ dizziness.

Exclusion criteria

Patients with ongoing/ recent ear discharge and perforation of tympanic membrane were excluded. Patients with acute symptoms of vertigo, unable to cooperate were excluded.

Method of collection of data

A patient when he reported was asked detailed history as per the proforma (see Proforma). Thorough Ear examination was done checking the tympanic membrane integrity, tuning fork tests, vestibular tests like rombergs test, unterberger test and tandem walking test. Then cerebellar tests were done. Central nervous system and other general examination parameters like Blood Pressure, pulse rate, pallor, tremors, neurocutaneous markers were all looked for. A clinical diagnosis was reached at this stage and then a Pure Tone Audiometry was done. Patient was asked to abstain from alcohol, labrynthine sedatives for 48 hrs prior to the testing. Patient then subjected to electronystagmography. ENG test battery was done in the ENG machine (RMS Nystagmorite MarkII) present in our department. Single channel electrodes were used and these electrodes were fitted at the lateral canthi of both eyes and at the centre of the forehead for ground electrode. Patient was then subjected to usual ENG test battery after calibration of the instrument. The light bar at adequate height and approx 5 feet distance was to used to make the patient look at the targets for gaze evoked and optokinetic tests. All the tests were recorded for a minimum of 30 sec and calibrated using the RMS standard software. Only 15 sec of the recording (a representative segment) was calibrated. As for caloric tests, the culmination frequency was measured manually at the culmination phase and the butterfly chart was used to interpret the outcomes.

Caloric testing was done with warm water at 44degrees centigrade and cold water at 30degrees centigrade used to flush the external auditory canal. About 40ml was used and a 10cc syringe used to gently push the water of the appropriate temperature for 30 sec time period into the ear. Recording is started once the water is being injected. The nystagmus is recorded with eyes closed for a period of two minutes and patient is made to do simple mental arithmetic during that time. After two minutes, he is instructed to fix his gaze on the ceiling fan and the abolishing of peripheral nystagmus is noted.

The recordings are then analyzed and the butterfly chart computed. Any new findings in the ENG are noted and correlated clinically. Further investigations (CT/MRI brain, BERA, OAE, speech audiometry, impedance audiometry, glycerol test, 4 vessel doppler) if needed are ordered and specialist opinions obtained. (Neurologist, Ophthalmologist, Physician, Cardiologist, Orthopedic Ian). Based on all these a corrected diagnosis is obtained and patient treated according to standard textbook protocols.

Butterfly chart

Normal culmination frequency values:

- Right warm: 22 to 59 beats per 30 sec.
- Right cold: 24 to 67 beats per 30 sec.
- Left warm: 23 to 63 beats per 30sec.
- Left cold: 27 to 63 beats per 30 sec.

RESULTS

The clinical diagnosis that was arrived in the 50 cases was as follows. Of the fifty cases, there were 23 cases of central vertigo and 27 cases of peripheral vertigo. Most common diagnosis was BPPV. The second and third most common diagnosis were vestibular migraine and phobic postural vertigo or psychogenic vertigo. Menieres and Ischemic causes were also common. Also few cases of vertigo of cervicogenic origin, anemic etiology, Toxic vertigo and acoustic neuroma were seen.

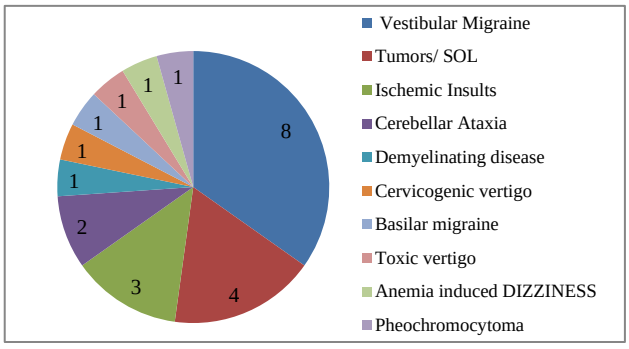

Figure 1: Central lesions causing vertigo: 23 cases.

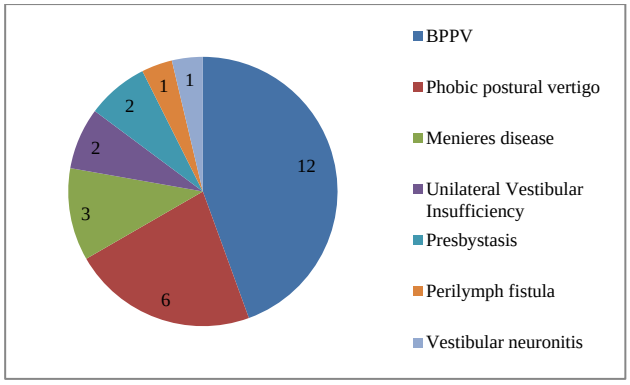

Figure 2: Peripheral lesions causing vertigo: 27 cases.

Of the fifty cases, there were 23 cases of Central Vertigo and 27 cases of peripheral vertigo. Most common diagnosis was BPPV. The second and third most common diagnosis were vestibular migraine and phobic postural vertigo or psychogenic vertigo. Menieres and ischemic causes were also common. Also few cases of vertigo of cervicogenic origin, anemic etiology, Toxic vertigo and acoustic neuroma were seen.

Table 1: Common butterfly patterns in my study.

S.no	Butterfly code	Peripheral lesion	Central lesion	Total
1.	0000	17	8	25
2.	2222	1	4	5
3.	1111	-	1	1
4.	0222	-	2	2
5.	2200	-	4	4
6.	1100	1	-	1
7.	0011	1	-	1
8.	2000	3	2	5
9.	0002	1	-	1
10.	0020	-	2	2
11.	1000	1	-	1
12.	0100	1	-	1
13.	0001	1	-	1
14.	Total	27	20	3

The most common code was the normal butterfly – 0000 which was seen in 50% of the patients – of these 68% was due to peripheral lesions and 32% due to central lesions. The next most common was the major butterfly – 2222 which was almost exclusively in 4 central lesions which was seen in 10% of cases. Of this only one case had this pattern in a peripheral lesion. This signifies the error of the machine. 2200 was the third most common – seen in 8% cases exclusively central lesions. Of the 27 common butterfly codes mentioned by Prof. Claussen, Thirteen were encountered in our study. Of these the last six could be considered as variants of normal. The Minor butterfly 1111 was seen in one case of toxic vertigo due to phenytoin. Of the above patterns, 2222, 1111, 0222, 2200, 2000, 0002, 0020 are seen in central pathologies. Of the above patterns, 1111, 1100, 0011, 2000, 0002, 0020, 0001, 0100, 0001 are seen in peripheral lesions.

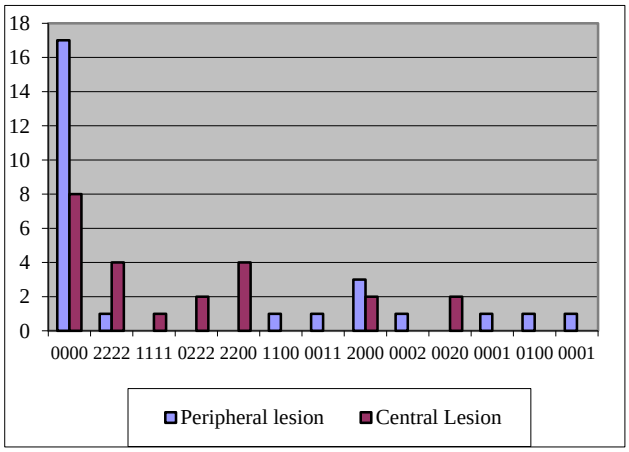

Figure 3: Common butterfly codes.

Butterfly code vs central lesions

For all patients with central vertigo (causes stated above), the Butterfly codes for central vertigo obtained in the RMS ENG have been taken as positive. The others have been taken as negative. The positive ENG codes for a central lesion are 2222, 0222, 0022, 2200, 2000, 0002, 0020, 1111. All others are negative codes for a central lesion.

Table 2: Correlation of butterfly code and central lesion.

Butterfly code	Positive	Negative	Total
Central lesion	15	8	23
No	5	22	27
Total	20	30	50
Sensitivity	75%		

Table 3: Statistical analysis for sensitivity of butterfly code.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-square	11.286 (b)	1	0.001		
N of valid cases	50				

a: Computed only for a 2x2 table; b: 0 cells (0%) have expected count less than 5. The minimum expected count is 9.20.

The sensitivity of the butterfly code for central lesions is 75%. The specificity of the butterfly code for central lesions if 73%. The positive predictive value is 65% and the negative predictive value is 81%. Also Chi Square testing for the above variables show that this result is Significant with a $p<0.001$.

Butterfly code vs peripheral lesions

For all patients with peripheral vertigo (causes stated above), the Butterfly codes for peripheral vertigo obtained in the RMS ENG have been taken as positive. The others have been taken as negative. The Of the thirteen codes encountered in our study, 1111, 0011, 1100, 1000, 0001, 0100, 2000, 0020, 0002 are considered as positive codes for a peripheral lesion.

Table 4: Correlation of butterfly code for peripheral vertigo.

Butterfly code	Positive	Negative	Total
Peripheral lesion	9	18	27
No	5	18	23
Total	14	36	50
Sensitivity	64.3%		

Table 5: Statistical analysis for sensitivity of butterfly code.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.828 (b)	1	0.363		
N of Valid Cases	50				

a: Computed only for a 2x2 table; b: 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.44.

The sensitivity of the butterfly code for peripheral lesions is 64.3%. The specificity of the butterfly code for peripheral lesions is 50%. The positive predictive Value is 33.3% the negative predictive value is 78.3%. However the Chi Square testing for the above variables show that this result is not Significant with a p>0.05 (0.363).

Role of imaging in patients with vertigo

For all patients with central vertigo (causes stated above), the patients who had imaging findings were taken as positive. The others have been taken as negative.

Table 6: Correlation of imaging and vertigo.

S. no	Brain imaging	Positive findings	Normal	Total
1.	**Central lesion**	11	12	23
2.	**Peripheral lesion**	3	10	13
4.	**Total**	14	22	35

The sensitivity of imaging in this study was 78.6%, specificity of imaging was 45.5%. The positive predictive value was 47.8%. Negative predictive value was 76.9%. The Chi Square testing for the above variable shows these results to be insignificant as the p>0.05 (0.143).

DISCUSSION

There have been numerous studies about the caloric response and the electronystagmography from as early as 1964 by Mehra about electronystagmography – a study of the caloric response on normal subjects, where they have performed the caloric test and recorded the response using the conventional ENG machine. It is of important historical perspective.[16]

In a study by Singh 25 patients with complaints of vertigo were analyzed using the bithermal caloric test and the ENG test battery.[15] 2 patients had spontaneous nystagmus in that study. Of the twelve common patterns of butterfly codes encountered in the study, 0000 was the commonest (32%) and 2222 was next most common (8%). Also 28% cases were of peripheral origin and 36% were of central etiology. Though it was not a detailed study on the etiology, it provided detailed information as to the culmination frequency and its importance in estimation of the caloric response.

Comparison with similar studies in the past

In my study, central vertigo was 46% of cases (23 out of 50) and peripheral vertigo was 54% (27 out of 50 cases). This is a similar figure quoted by Dr. Gurumani. There are certain fundamental questions that need to be addressed. There is so much still unknown about the pathophysiology of many diseases causing vertigo. For instance, Vestibular migraine is being classified as a Peripheral vestibular lesion in studies by Dr. Gurumani.[6] Whereas it is being considered as a Central Vestibular lesion in studies by Dipjyoti, Strupp and Brandt and Burman.[9,17,18] In my study also I've considered it as a Central vestibular lesion after verifying textbooks - Scott Brown and Strupp. Similarly a dilemma exists for the classification of phobic postural vertigo which is again classified as a peripheral disorder by Strupp and Brandt, however Gurumani and Dipjyoti classify it under central pathology. I've considered it under peripheral lesion after Strupp and Brandt who have characteristically outlined the clinical features of this condition. However the study by Dr. Burman on peripheral vertigo also does not include this diagnosis in their observation. Similarly for vestibular schwannoma, It can be a considered a peripheral or a central cause of vertigo. Scott brown textbook considers it part of the central vestibular system and so I consider it as a central lesion whereas Dipjyoti, Burman, Gurumani and Strupp and Brandt all consider it as peripheral cause for vertigo. Similarly a confusion exists for vestibular paroxysmia. I have according to Scott Brown and Strupp and Brandt considered it as a central lesion.

ENG is a simple, non-invasive and quick investigation in the armamentarium of Neurotologists. It has been said in studies by Buki that, sensitivity of the ENG for peripheral lesions is 31% and specificity 86%.[11] In my study however, sensitivity of butterfly chart for peripheral

lesions was 61.5% and specificity – 48.6%. This also suggests that using a butterfly chart to solely to diagnose a Peripheral vestibular pathology would be impossible. However history and clinical investigation form an important asset and together help in the accurate diagnosis of peripheral disorders.

Table 7: Comparison of butterfly codes in various studies.

S. no	Diagnosis	My study	Burman[18]	Strupp and Brandt[17]	Dipjyoti[9]	Gurumani[6]
1.	BPPV	24	20	18.6	44.23	41.83
2.	Phobic postural vertigo	12		15.6	10.71	
3.	Menieres disease	5	10	9.4	19.23	28.57
4.	Vestibular neuronitis	2	6.4	7.4	13.4	14.28
5.	Perilymph fistula	2	17.9	0.6	3.85	
6.	Prebystasis	4				
7.	Unilateral vestibular insufficiency	4				
8.	Vestibular migraine	18		10.2	14.28	5.10
9.	Tumors/ SOL	8	13,6			
10.	Ischaemia	6	10.5		14.28	25
11.	Cerebellar ataxia	4				
12.	Cervicogenic vertigo	2	6.4		25	
13.	Toxic vertigo	2			3.57	
14.	Anemia	2			7.14	
15.	Others	4		10.3		33.33

The negative predictive value for butterfly code for both central and peripheral lesions is high and hence we can with some confidence say that in case of negative code the lesion can be confidently excluded from the central system within the horizontal VOR pathway and selected peripheral areas. Arriaga et al determined that Rotational chair testing has a sensitivity of 71% for diagnosing peripheral vestibulopathies, as opposed to only 31% sensitivity for caloric testing/ENG.[10] Although it is a more sensitive test for peripheral vestibular disorders, Rotational chair testing has a specificity of only 54%, compared with the 86% specificity of ENG. Both tests are therefore complimentary and should be used in the diagnosis of peripheral vestibular dysfunction.

Comparing butterfly code and imaging for central vertigo

In my study, sensitivity of butterfly chart for diagnosing Central lesions is 75% and specificity is 73%. Hence ENG is more useful as an investigation in patients with a central cause for their vertigo especially if no lesion is detectable on Imaging. However another study has said that ENG remains a more useful investigation in Vertigo patients than MRI by stating that Electronystagmography contributed to establishment of a diagnosis in 53/102 patients (52 per cent), whereas magnetic resonance imaging did the same in four of 102 patients (3.9 per cent).[13] In my study the sensitivity of brain imaging (both CT and MRI together) came out to be 48% and its specificity was 62% in diagnosing the etiology. Thus the butterfly code is more sensitive and specific to diagnose a central cause of vertigo and localize side of lesion as compared to imaging.

The sensitivity of butterfly chart for peripheral lesions was 61.5% and specificity 48.6%. The sensitivity of butterfly chart for diagnosing central lesions is 75% and specificity is 73%. In my study the sensitivity of Brain Imaging (both CT and MRI together) came out to be 48% and its specificity was 62% in diagnosing the etiology of central vertigo. Thus the butterfly chart and electronystagmography are more sensitive to diagnose vertigo of central etiology than Imaging. The relevance of this investigation is undoubtedly proven in the cases where there were no organic lesion to diagnose and yet butterfly code and ENG showed a positive findings. In these cases undoubtedly there is no alternative to substitute the ENG. Even in patients with organic lesions not yet diagnosed, the ENG has a definitive role in the diagnosis. In patients with central pathology (in cases within its scope), it is also possible to localize these lesions to one side or the other and also to certain specific areas in the brain that correspond to the VOR pathways using the ENG.

CONCLUSION

This is the first study done in South India of this nature. The importance of asking for an electronystagmography study in a patient with central vertigo cannot be further emphasized. Also in patients with a peripheral lesion, the ENG is of lesser but definitive value. This can be especially inferred in those cases of U/L or B/L Menieres disease which may otherwise have normal findings and in cases of U/L or B/L vestibulopathy where there are no overt signs in the chronic/ recovery phase due to ongoing vestibular rehabilitation. It is also possible to identify lesions causing vestibular stimulation or suppression and

thus plan our management accordingly. Thus The Butterfly coding is a useful investigation for diagnosing Peripheral vertigo but it is a both sensitive and specific investigation to diagnose Central vertigo (more sensitive and specific than Imaging -CT and MRI).

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kruschinski C, Kersting M, Breull A, Kochen MM, Koschack J, Hummers-Pradier E. -Frequency of dizziness-related diagnoses and prescriptions in a general practice database. Z Evid Fortbild Qual Gesundhwes. 2008;102(5):313-9.
2. IAN (Indian Academy of Neurology) Guidelines on vertigo, 2nd Edition.
3. Neuhauser HK. Epidemiology of vertigo. Curr Opin Neurol. 2007;20:40–6.
4. Froehling DA, Silverstein MD, Mohr DN, Beatty CW. Does This Dizzy Patient Have a Serious Form of Vertigo? JAMA. 1994;271(5):385-8.
5. Jacobson GP, McCaslin DL, Piker EG, Gruenwald J, Grantham S, Tegel L. Insensitivity of the "Romberg test of standing balance on firm and compliant support surfaces" to the results of caloric and VEMP tests. Ear Hear. 2011;32(6):e1-5.
6. Gurumani S. Prospective Study of Vertigo – Causes, Incidence, Audiometric Findings & Caloric Tests. Int J Medical Applied Sci. 2013;2(3):1.
7. Bakr MS, Saleh EM - Electronystagmography: how helpful is it? J Laryngol Otol. 2000;114(3):178-83.
8. Cass SP. Best Practices for the Evaluation and Management of Dizziness – Insighta in practice, Clin Topics Otoneurol. 2005.
9. Dipjyoti B, Bhattacharjee A, Purkaystha P, Rathor A. A clinical study on vertigo with special reference to audiovestibular tests. Int J Sci Res. 2013;2(7):370-5.
10. Arriaga MA, Chen DA, Cenci KA - Rotational chair (ROTO) instead of electronystagmography (ENG) as the primary vestibular test. Otolaryngol Head Neck Surg. 2005;133(3):329-33.
11. Büki B, Simon L, Garab S, Lundberg YW, Jünger H, Straumann D. Sitting-up Vertigo and Trunk Retropulsion in Patients With Benign Positional Vertigo but Without Positional Nystagmus. J Neurol Neurosurg Psychiatr. 2011;82:98-104
12. Felipe L, Carvalho SA, Labanca L, Tavares MC, Gonçalves DU. Validity of the monothermal caloric testing when compared to bithermal stimulation - Pró-Fono Revista de Atualização Científica. 2010;22(1):1.
13. Korres S, Riga M, Papacharalampous G, Chimona T, Danielidis V, Korres G. Xenellis ENT Department, Hippokration Hospital, University of Athens, Greece. - Relative diagnostic importance of electronystagmography and magnetic resonance imaging in vestibular disorders. J Laryngol Otol. 2009;123(8):851-6.
14. Ganança MM, Caovilla HH, Ganança FF. Electronystagmography versus videonystagmography. Braz J Otorhinolaryngol. 2010;76(3):399-403.
15. Singh BK, Bapna AS, Chhangani DL. Interpretation of ENG by Claussens Butterfly Chart. Indian J Otolaryngol. 1987;39(4):145-9.
16. Mehra YN. Eletronystagmography: A study of caloric tests in normal subjects. J Laryngol Otol. 1964;78:520-9.
17. Strupp M, Brandt T. Diagnosis and Treatment of Vertigo and Dizziness. Dtsch Arztebl Int 2008;105(10):173–80.
18. Burman D, Goswami, Majumdar PK. A study on peripheral vertigo in a kolkata based hospital - Indian J Otolaryngol Head Neck Surg. 2002;54(2):101-4.

Cite this article as: Meenakshi S, Venugopal M, Rajasekar MC. Correlation between clinical diagnosis and claussens butterfly chart patterns in patients with vertigo. Int J Otorhinolaryngol Head Neck Surg 2019;5:587-92.