CHAPTER 3

METHOD

The aim of the present research was to study audiovestibular profile and quality of life in individuals with BPPV. The study was carried out prospectively using quasi-experimental design. The method used to investigate the aims and objectives of the study is described in this section.

3.1 Participants

Present research included two groups of participants, Group I consisting of 40 healthy participants and Group II comprising of 92 participants with BPPV. The age of the participants ranged from 40 to 70 years. The inclusion and exclusion criteria for the two groups are described below.

3.1.1. Group I (Healthy Individuals)

3.1.1.1 Inclusion Criteria: Criteria for including participants in Group I were as follows**:**

- Pure tone average less than 25 dB HL at octave frequencies from 250 Hz to 4000 Hz for air conduction and bone conduction tests
- 'A' type tympanogram
- Acoustic reflex threshold within 100 dBHL at the octave frequencies between 500 Hz to 4000 Hz
- Native Speaker of Marathi Language

3.1.1.2Exclusion Criteria: Participants with following characteristics were excluded from **Group I**

- History of dizziness

- Known history of diabetes or hypertension,
- Known history of anemia, spine disorders,
- Known history of renal disorders
- Known history of Psychiatric disorders
- Known history of vestibular or neurological diseases
- Presence of eye abnormalities, Squint or blindness.

3.1.2 Group-II

3.1.2.1. Inclusion criteria: Inclusion criteria for Group II were as follows**:**

- History of dizziness
- Positive Results on Dix-Hallpike Maneuvers or Roll Maneuver as per the guideline of American Academy of Otolaryngology – Head and Neck Surgery (Bhattacharya et al, 2008). Diagnosis of BPPV was made with an observation of torsional upbeating geotropic nystagmus triggered by the Dix- Hallpike maneuver. Whenever Dix-Hallpike test did not reveal any nystagmus, roll maneuver was performed to identify and diagnose the participants with BPPV of horizontal canal
- No middle ear pathology as indicated by immittance evaluation
- Native speaker of Marathi language

3.1.2.2 Exclusion criteria: Participants with following characteristics were excluded from the Group II

- Known history of uncontrolled medical condition such as diabetes and hypertension
- Known history of anemia, spine disorders, renal disorders at the time of testing
- Known history of psychiatric disorders
- Known history of neurological diseases
- Presence of squint or blindness
- Known history of disorders/infections of vertebral spine or neck that prevents performing any diagnostic Maneuvers

3.3 Instrumentation

The following equipment were used:

- A calibrated Orbiter 922 double channel audiometer with TDH-39 earphones and B-71 bone vibrator
- A calibrated Amplaid-556 screening immittance meter
- SYNAPSYS Digital- Nystagview V3.2 RevL with Ulmer video nystagmoscopy goggle (VNS 3X),
- Biologic EP (Version 7.0.0) with TDH 39 headphones for recording of cVEMP

3.4 Test Material

3.4.1 Dizziness Handicap Inventory (DHI)

DHI is a disease specific questionnaire developed by Jacobson and Newman (1990). It has total 25 questions divided into three domains named Physical, Emotional and Functional. Physical Domain has 7 questions while functional and emotional domain has 9 questions. A three point rating scale is used. A score of 4 is given for 'yes' while a score of '2' is given for 'sometimes' and 'no' is scored as zero. Total attainable score on the scale ranges from 0 to 100. Persons with a score of 10 or less than 10 are considered as having non-significant handicapping effect of dizziness on person's life while persons with the score of 10 to 40 are considered as having mild handicap due to dizziness. Persons having score of 41 to 70 are reported to be have moderate handicap and those with a sore of more than 70 are considered as having severe Handicap due to dizziness (Jacobson, 1990).

3.4.2 WHOQOL - BREF

The second questionnaire WHOQOL BREF is a generic questionnaire developed by WHOQOL Group as a multilingual, multidimensional profile of QOL for cross cultural issues (WHOQOL group, 1998). It has four subscales measuring physical health, psychological well-being, Social relationship and satisfaction with the environment. Physical Health included

activities of daily living, dependence on medical substance and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest and work capacity, psychological wellbeing such as bodily image and appearance, negative feelings, positive feelings, self-esteem, spirituality, personal beliefs and thinking, learning, memory and concentration. The Social relationship consists of the personal relationships, social support and sexual activity. Environmental domain consists of financial resources, freedom, physical safety and security, health and social care, accessibility and quality, home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreational activities, physical environment (pollution/noise/traffic/climate) and transport. It has a total 26 questions across the 4 domains. Response of each question is rated on a 5 point rating scale (1 to 5) where 1 indicates worse quality of life and 5 indicates absolutely no difficulty in carrying out the task. Total score on the questionnaire ranges from 26 to 136, wherein 26 indicated most affected QOL while 136 shows no compromise on QOL. As number of questions covered under each domain is not even, the score of each domain is transformed into 100 as per the guideline provided by WHOQOL-BREF.

Both scales have been adapted to Marathi using a forward and backward translation procedure. Five individuals proficient in both languages were asked to validate the translated versions of each questionnaire.(Mishra & Vanaja, 2010; Kapoor & Sarda, 2012). Pilot study was carried out to check the reliability of translated scales. Both the questionnaires were administered on 30 individuals with dizziness and scores were later exposed to Cronbach's alpha reliability test. Results revealed high reliability of 0.78 and 0.084 in persons with dizziness for Marathi version of DHI and WHOQOL-BREF respectively. A copy of Marathi translated version of DHI and WHOQOL-BREF is attached as Appendix A and B.

3.4.3 Case History

Dizziness related case history which was developed at the BVDU School of Audiology and Speech Language Pathology, Pune was used .It consists of questions related to symptoms, duration, frequency of dizziness, feeling of imbalance and conditions in which dizziness increases or decreases in its severity level. It also included hearing related questions such as history of hearing loss, tinnitus, ear discharge and treatment taken for it. Questions to collect information related to any other medical and neurological conditions were also included. .A copy of Case history Proforma is attached as Appendix C

3.5 Ethical Consideration

The study was approved by the Ethical committee of Bharati Vidyapeeth University Medical College. Following the guidelines of the ethical committee, all the participants were informed about the research study through participant information sheet and written consent was taken before considering the participants for the research study. A copy of the participant information sheet and informed consent is attached as Appendix D and E

3.6 Procedure

Initially a detailed case history designed specifically for individuals with complaint of dizziness was administered. Followed by the case history, all the participants of Group II underwent Dix-Hallpike test for the diagnosis of BPPV. Dix Hallpike test was done using infrared video camera of VNG instrument. Participants were instructed to sit with head turned 45 degree to one side in vision denied condition with examiner standing behind the participants. Examiner's one hand was grasping the top of the participants head and other hand was against the neck. Participants were then rapidly pulled to supine heading hanging position with neck in the turned position. If up beating nystagmus was observed in supine condition with a latency of 3-5 sec and adaptation within 15-20 sec, client was diagnosed to have posterior canal BPPV.

Roll maneuver was administered for participants who showed negative results on Dix-Hallpike test. Participants who showed nystagmus on roll maneuver with characteristics of peripheral vestibular pathology, were diagnosed to have BPPV of horizontal canal. Participants of both the groups underwent pure tone audiometry, Immittance evaluation, Videonystagmography (VNG) and cervical Vestibular Evoked Myogenic Potential (cVEMP). Detail Audiovestibulae tests were carried out in order to differentiate primary and secondary BPPV among the participants of Group II.

3.6.1 Pure Tone Audiometry and Immittance Evaluation

Pure tone thresholds were obtained using modified Hughson and Westlake method (Carhart and Jerger, 1959) at octave frequencies from 250Hz to 8000 Hz for air conduction and 250Hz to 4000Hz for bone conduction. The non-test ear was masked, wherever required. Tympanometry was carried out using 226 Hz probe tone. Ipsilateral and contralateral acoustic reflex thresholds were obtained for 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz.

3.6.2 Videonystagmography (VNG)

VNG with monocular approach was performed on all the participants. The eye movements were recorded by an infrared video camera. The participants were instructed not to consume caffeinated beverages or food 4 hours prior to testing and alcohol or antivertiginous medicines 48 hours prior to test. All the participants were made to sit in a comfortable position and the goggles were placed. The tension of head band was adjusted as required. It was ensured that there was no light entering the eyes. The calibration test was done in vision enabled condition with participants' eyes wide open in a dark situation to maintain geographical proximity between 8-12 ranges. The following tests were carried out after the calibration:

3.6.2.1 Spontaneous Nystagmus test

Ocular movements was recorded for approximately 20 seconds in vision denied condition by closing the cover on the VNG goggles. If a spontaneous nystagmus was detected, then recording was carried out for an additional 20 seconds in vision enabled condition.

3.6.2.2 Gaze Nystagmus test

First the recording was done in vision denied condition with participants fixing his/her vision at a point located at 0 degree angle. Then the participants was asked to shift his/her focus from the 0 degree angle to 30 degree of his/her right side and then to the 30 degree left side. At every point there was a fixed stationary object for fixating the vision and recoding was done for 30 seconds at each of these points. If the nystagmus was observed in vision denied condition, then recording was repeated in vision enabled (Visual fixation) condition.

3.6.2.3 Positional Nystagmus test

Similar to Gaze Nystagmus test, Positional Nystagmus test was also carried out first in vision denied condition then in vision enabled condition. Recording was carried for 30 seconds in each of following positions, sitting position, supine position with head in line with chest, supine position with head turned to 60 degree to right side, supine position with head turned to 60 degree to left side and supine position with head in hyperextended position

3.6.2.4 Caloric test

For caloric test, the participants were instructed regarding warming and cooling of external ear canal by air irrigation. They were also informed about the possibility of dizziness for less than 2 minutes after the air irrigation of external ear canal. All the participants were made to lie down in supine position with the head anteroflexed in 30 degrees throughout the procedure. This position has been recommended so that the horizontal semicircular canal was in vertical plane for maximum stimulation. The VARIO air caloric irrigator was used to irrigate the ear with

cold air and warm air. The temperatures maintained for the cold irrigation was 27 °C ±0.4 °C and 44 °C ± o.4 °C for warm irrigation. The irrigation of warm and cold air was delivered separately in both ears, one at a time. The order of presentation was, warm stimulus to the right ear, warm stimulus to the left ear, cold stimulus to the right ear and cold stimulus to the left ear. Each irrigation was delivered for a duration of 45 seconds and the recording of eye movements was continued till 120 sec. A mental task such as simple addition or reverse counting was given immediately after stopping irrigation until the completion of recording of eye movements. A break of 6-10 min was given between two irrigations.

For recording the SPV values, the nystagmus was analyzed in a time window of 60 to 90 seconds post irrigation. Initially nystagmus value for the strongest beat was measured between the time window of 60 to 70 sec. Similarly it was recorded between the window of 70 to 80 seconds and 80 to 90 seconds. The SPV values recorded across these three time windows were averaged. This averaged SPV value was considered as the Maximum (strongest) SPV value for that particular irrigation and this was considered for further analysis. The unilateral weakness was determined by comparing the sum of the SPV of the right ear warm and right ear cold and the sum of SPV for left ear warm and left ear cold responses. Following formula given by Jongkees and Philipszoon (1964) was used to measure the Unilateral Weakness:

$$\frac{(RC + RW) - (LC + LW)}{(LC + LW) + (RC + RW)} \times 100 = \text{Unilateral Weakness}$$

Where,

RW - Right ear warm response
RC - Right ear cold response
LW- Left ear warm response
LC- Left ear cold responses

3.6.2.6 Vestibular Evoked Myogenic Potential (cVEMP)

cVEMP test was recorded from all the participants to assess the functioning of their inferior vestibular nerve/ saccular / vestibulocolic (VCR) pathway. cVEMP (Cervical vestibular evoked myogenic potential) was recorded in the sitting position with the head rotated away from the stimulated side. The Sterno-cleidomastoid muscle tension was maintained by instructing the client subjects to turn their neck to the opposite side and attempt to touch their chin to a reference point. Reference point was maintained by means of a pen which was held on the opposite shoulder. cVEMP was recorded using the protocol given in Table 3.1 and 3.2. Two consecutive recordings were carried out to confirm the reproducibility of the peaks. The first positive and second negative peaks of the biphasic waveform were termed waves P13 and N23, respectively. The latencies of P13, N23, and amplitude P13-N23 were measured.

Table 3. 1 *Stimulus parameters used recording VEMP*

Stimulus	500Hz tone burst
Duration	10 ms
Stimulus rate	5.1/sec
Polarity	Rarefaction
No. of sweeps	300
Intensity	95dBnHL
Transducers	TDH-49 supra-aural earphones

Table 3.2 *Acquisition parameters in the Protocol used to record VEMP.*

Mode	Ipsilateral
Electrode type	Non disposable, disc electrode
Electrode montage	Ground/common-Forehead
	Non inverting-middle portion of sterno-cleido mastoid muscle (SCM)
	Reference/inverting- upper sternum
Analysis window	0 to 40 msec
Filter settings	20 to 2000Hz
Notch filter	Off
Impedance	Intraelectrode10 K ohm
	Interelectrode: within 20Kohm

3. 6.2.7 Assessment of Quality of life

Assessment of self-perceived handicap and general quality of life was assessed using Marathi version of Dizziness Handicap Inventory and WHOQOL-BREF in an interview mode.

3.7 Data Analysis

Pure tone average (PTA) was calculated using the thresholds at 500 Hz, 1000Hz and 2000 Hz frequencies of right as well left ears separately. Average SPV values across four irrigations and canal paresis value were used for analyses of caloric response. For cVEMP test, presence versus absence of waveform, latency of P13 and N23 peaks and amplitude parameters of P13-N23 peak were considered for analyses. Score from both the questionnaire (DHI, WHOQOL-BREF) was calculated to obtain total score and scores for each domain, the response "not applicable" and unanswered questions were treated as missing values. To compare the domains of DHI among themselves, raw values of each domain were converted into percentage. Statistical analyses were carried out using SPSS version 20.0 to investigate the objectives of the study.