Original Article

Effectiveness of the Canal Repositioning Procedure in Treating Benign Paroxysmal Positional Vertigo Associated with Mild Traumatic Brain Injury

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Abstract

Background: Benign Paroxysmal Positional Vertigo (BPPV) is thought to be one of the most frequently occurring but undiagnosed causes of dizziness and imbalance as a result of Mild Traumatic Brain Injury (mTBI). Though the Canal Repositioning Procedure (CRP) is a very effective for idiopathic BPPV, there are varied results on the effectiveness of the same on post-traumatic BPPV in the Indian population. The aim is to compare the efficacy of the Canal Repositioning Procedure in the management of the posterior canal BPPV related to mild traumatic brain injury. **Material and Methods:** It was a descriptive observational study involving patients with mTBI aged 18 to 70 years who presented to the survey within 48 hours to 7 days after the injury. Day 3 would have been ideal, but Day 7 was the latest date on which the screening with the Dix-Hallpike Test was performed. CRP (Epley maneuver) was performed on all patients diagnosed with posterior canal BPPV. At 2, 4, and 6 weeks, follow-ups were conducted to evaluate symptom resolution. **Results:** 19% of patients with mTBI were reported to have PCBPPV. CRP resulted in symptom resolution of 73.6%, 89.4%, and 100% at 2 weeks, 4 weeks, and 6 weeks, respectively. **Conclusion:** CRP is safe, easy, and highly effective for treating BPPV following mTBI. Post-traumatic morbidity can be greatly minimized by routine screening and timely CRP.

Keywords: Head Injury, Vertigo, Dix-Hallpike Test, Epley Maneuver.

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Introduction

One of the biggest global public health issues is traumatic brain injury (TBI).[1-3] The incidence of TBI is almost 3 times higher in poor and middle-income countries than in high-income countries.[4] The relationship between the incidence and the healthcare system is increasing in India, with 1.5-2 million cases per year.[5] TBI is a form of injury that has a broad spectrum of neurological injuries, such as mild concussion and serious brain damage, and is also ranked as one of the most frequent causes of long-term disability globally.[6] Mild traumatic brain injury (mTBI) is usually characterized in terms of a Glasgow Coma Scale score of 13-15, a short or no loss of consciousness, and normal neurological and radiological results.[6] It can include dizziness, disorientation, and short-term loss of consciousness lasting no more than 30 minutes.[7] Headache and dizziness are some of the most common post-injury symptoms, and dizziness has been the most commonly complained-of symptom following TBI. Balance problems usually go hand in hand with headaches, and post-traumatic headache patients tend to exhibit disabilities in balance functioning.[8] Among the leading causes of post-concussion symptoms in 24-83% of patients with mTBI, there is vestibular dysfunction, Traumatic brain injury, and vestibular pathology as a comorbidity after exposure to blast.[9] A different study shows that between 27 and 52 percent of mTBI patients experience intractable balance difficulties.[10] This prevalence is important for the diagnosis and treatment of dizziness after a head injury.[11] Post-TBI dizziness, including vertigo, disequilibrium, or lightheadedness, can significantly complicate clinical assessment.[10] The symptoms usually develop as a result of peripheral vestibular damage, especially of the inner ear.[12] The peripheral vestibular system contains three semicircular canals that detect angular acceleration in head movements.[10] It also has two organs, the saccule and utricle, which are organs of linear acceleration and head tilt and aid in maintaining posture and gaze stability.[10] These structures are dysfunctional, particularly the saccule, and result in serious balance impairment in the TBI patients. There is a prevalent vestibular pathology known as Benign paroxysmal positional vertigo (BPPV) that can significantly impair the quality of life and functional independence that may occur after

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a head injury.[13] BPPV has a lifetime prevalence of 2.4 per cent and accounts for 20-30 per cent of referrals to vestibular clinics.[14] It can be as high as 64 per 100,000 individuals.[15] BPPV is distinguished by occurring in short-term vertigo situations brought about by alterations in the position of the head in reference to gravity.[13] This fact is indicated by the high prevalence of BPPV, which implies that otolith dysfunction is very common among such patients.[16] BPPV is either idiopathic or secondary; head trauma is a contributing factor to 7-17%,17] and the traumatic BPPV is 8.5-20% (18) of all cases. Traumatic BPPV is more likely to produce more serious symptoms and is more recurrent.[19]

The pathophysiology typically involves the dislodging of otoconia and their movement into the semicircular canals, most commonly into the posterior canal.[20] The Dix-Hallpike test is used to diagnose posterior canal BPPV, as it provokes typical vertigo and torsional nystagmus.[21] The test is based on the ability to move the otococal debris in the canal, which results in the nystagmus due to the cupula deflection.[22] Posterior canal BPPV is 80-90% and horizontal canal is next.[13] The canalithiasis or cupulolithiasis may be the cause of BPPV because of either a free movement of otoconia in the canal or their adhesion to the cupula.[23] Traumatic BPPV can be witnessed within 3 days and 3 months of injury.[24] The Epley maneuver is quite useful for treating posterior canal BPPV, resolving symptoms in 90% of patients.[25] As such, the purpose of our research was to identify the percentage of BPPV among patients with mild traumatic brain injuries and also to assess the efficacy of the Canal Repositioning Procedure in the treatment of BPPV and mTBI.

Materials and Methods

The rationale for the current study was to examine the prevalence of benign paroxysmal positional vertigo in mTBI patients and to determine the usefulness of the canal repositioning procedure in the management of BPPV in these patients. In order to realize this objective, one hundred participants aged between eighteen and seventy years who had complained of dizziness within forty-eight hours and seven days of mTBI had been included.

This observational descriptive study covered 100 patients who had suffered mild traumatic brain injury, aged 18-70 years, and had presented to the Department of Otorhinolaryngology of a tertiary care centre within 48 hours to 7 days following the head trauma. Day 3-7 of mTBI, Vestibular examination, as well as the Dix-Hallpike Test (DHT) was performed, and Canal Repositioning Procedure (Epley maneuver) done in positive patients. The follow-up assessment was conducted at 2, 4, and 6 weeks. Symptom resolution, persistence, or recurrence were measured as outcome measures. The statistical analysis was performed using the chi-square test and percentage distributions.

Inclusion criteria:

1. Age between 18 years and 70 years
2. Patients who complain of dizziness between 48 hours and 7 days following mTBI.

Exclusion criteria:

1. History of BPPV before head injury
2. Previous history of ear disease
3. Co-morbid condition or trauma that does not allow the use of the Dix-Hallpike manoeuvre (e.g., cervical spine fracture, cervical pain).

1. Diagnostic procedure:

All the patients with mild traumatic brain injury were present. They had undergone detailed history-taking, clinical examination, and a full ENT examination as per the proforma, which was constant throughout the study. Glasgow Coma Scale differentiated Mild Traumatic brain injury scores 13-15, loss of consciousness not encountered or may have transient loss of consciousness and normal in NCCT head, without any neurological deficit. [7,8] Subsequently, the Patient went through the Provocation test of BPPV (Dix-Hallpike test), which is a diagnostic test of BPPV, 3 to 7 days after head trauma.

2. Treatment procedure:

We had Canal Repositioning Procedure (Maneuver by Epley) after 3 days of mild traumatic brain injury.[26]

The patient was sitting on the examination table in a relaxed position after the confirmation of posterior canal BPPV. The process began with the head turned 45 degrees to the affected area. The patient was moved swiftly into a supine position, and the head hung roughly 30 °, whereas the 45 ° head turning remained constant. Vertigo and nystagmus were noted and allow to settle before moving to the next step. Then, 90 degree rotations towards the other side were performed on the head, and rest was taken once more until the symptoms subsided. This was followed by a 90° rotation of the head (or head and body together) so that the patient's face was facing downwards, approximately 135° from the original position. The patient eventually sat in a position, keeping the head bent forward at approximately 20 degrees. In individuals who experienced symptoms in both side, the more troubling side was initially treated, and the other was addressed by the end of the session.

Follow-up was at 2, 4, and 6 weeks.

Results

Nineteen percent of the mild traumatic brain injury patients were identified with posterior canal BPPV. The performance of the Canal Repositioning Procedure was measured at 2, 4, and 6 weeks.

These findings have been outlined in the section below.

i. Demographic details of Patients: As described by the client, all patients at our hospital are aged 18-70 years.

a. Age of the Patients: In our research we wanted to evaluate the percentage of BPPV among patients with mTBI and also, the success of the canal repositioning intervention in the management of BPPV in mTBI patients. To achieve this objective, 100 patients between the ages of 18 to 70 years, mean age of patient was 35.62 ± 12.45, who reported within 48 hours to 7 days after mTBI were selected. our recruited patients were those recruited by the Department of Otorhinolaryngology of territory care centre and volunteered to participate in our study.

The [Table 1 and 2] demonstrate the age and the gender of all the patients respectively.

Table 1: Demographic profile (age) of mTBI, expressed as the number of mTBI patients in the specified age group.

Age	Number	Percentage
18-20	10	10.0%
21-30	33	33.0%
31-40	28	28.0%
41-50	16	16.0%
51-60	10	10.0%
61-70	3	3.0%
	Total= 100	Total= 100.0%

Table 2: Demographic profile (gender) of mTBI patients, expressed as the number in the specified gender group.

a. Gender of the Patients:		
Gender	**Number**	**Percentage**
Male	87	87.0%
Female	13	13.0%
	Total= 100	Total= 100.0%

ii. Distribution of patients according to history of loss of consciousness (LOC)

We found that 41% patients had a history of loss of consciousness due to mTBI. In comparison, 59% patients had not reported any history of loss of consciousness after mild traumatic injury (mTBI) [Table 3].

Table 3: Number of patients who had a present/ absence history of loss of consciousness (LOC) as a result of mTBI. In terms of the number and percentage of patients with or without a history of loss of consciousness.

H/O LOC	Number	Percentage
Present	41	41.0%
Absent	59	59.0%
	Total= 100	Total= 100.0%

iii. Allocation of patients based on coma scale number (GCS): Since we had patients with invasive scores of 14 and 15, we discovered that all the mTBI scores recorded in this study were listed in [Table 4].

Table 4. Distribution of patients based on Glasgow Coma Scale score, expressed as the number and percentage of mTBI patients.

GCS Score	Number	Percentage
14	19	19.0%
15	81	81.0%
	Total= 100	Total= 100.0%

iii. Division of patients into Vertigo history: It shows the distribution of mTBI patients with vertigo, with 53% reporting vertigo after mTBI and 47% not reporting it.

Table 5. History of vertigo caused by mild traumatic brain injury (mTBI): a number and percentage of the mild traumatic brain injury patients with or without a history of vertigo.

Vertigo	Number	Percentage
Present	53	53.0%
Absent	47	47.0%
	Total= 100	Total= 100.0%

v. Posterior Canal BPPV patients (identified by Dix-Hallpike Test), Non-specific Dizziness patient, and no Dizziness patient in the first visit (Day 3-7 after mTBI), and stratified by age and gender in the period of mTBI post.

Out of the 100 patients examined during 3-7days after mTBI, the positive DHT in 19% confirmed that the patient had BPPV. Namely, 11 and 6 involved the right and left anterior canals, respectively, and 2 involved both sides. Age-wise analysis indicated that the 31-40 years age group contributed the highest number of 9 patients (47.4%) among the total BPPV patients. A trend was observed among younger and middle-aged adults, but the difference between the age groups was not significant. Correspondingly, regarding gender distribution, BPPV cases included 16 males (18.4%) and three females (23.1%). The outcome showed that gender and BPPV were not significantly related.

Table 6. mTBI patient's distribution in: anterior canal BPPV, nonspecific dizziness, and no dizziness. Stratification of the data is done with respect to age and gender. p-value below 0.05 was identified as significant. (n= number).

		Group						Fisher's Exact Test	p-value
		TBI and Posterior Canal BPPV		TBI and non-specific Dizziness		TBI and no Dizziness			
		N	%	N	%	N	%		
Age	18-20	0	0.0%	6	17.6%	4	8.5%	9.579	0.452
	21-30	5	26.3%	12	35.3%	16	34.0%		
	31-40	9	47.4%	7	20.6%	12	25.5%		
	41-50	3	15.8%	5	14.7%	8	17.0%		

	51-60	2	10.5%	4	11.8%	4	8.5%		
	61-70	0	0.0%	0	0.0%	3	6.4%		
Gender	Male	16	18.4%	31	35.6%	40	46.0%%	.908	0.732
	Female	3	23.1%	3	23.1%	7	53.8%		
	Total	19		34		47			

vi. Predominance and Positive - Negative Dix Hall Pike Test (DHT) response distributions in various time periods: It is the outcomes of DHT at different periods of time namely, at 3-7 days, 2 weeks, 4 weeks and 6 weeks after doing a maneuver by Epley. In the group at 3-7 days interval, of 53 patients who had a complain of vertigo, 19 patients were positive in terms of DHT and Epley maneuver performed. Others were recovered (14 patients) at the 2-weeks, and still positive in which the Epley Maneuver was performed (5 patients). There were 3 more recoveries occurred in 4th week and Epley maneuver performed in remaining 2 patients. The result of positive DHT was no longer statistically significant by the 6-weeks and no such DHT were observed. In general, the findings indicate a negative time dependence of positive DHT.

Table 7: Table characterize data on number and percentage of various time intervals (DHT 3-7 days, DHT 2 weeks, DHT 4 weeks and DHT 6 weeks) and their positive/negative outcomes. The level of significance is indicated as p < 0.05 (*), p < 0.003(**) and p < 0.0001 (**).

		Number	Percent	Z-proportion	p-value
DHT 3-7 days	Positive	19	19.0%		
	Negative	34	34.0%		
DHT 2 weeks	Positive	5	5.0%	3.12	.002**
	Negative	14	14.0%		
DHT 4 weeks	Positive	2	2.0%	4.08	.0001**
	Negative	3	3.0%		
DHT 6 weeks	Positive	0	0.0%	4.84	.0001**
	Negative	2	2.0%		
	Total	2	2.0%		

Discussion

Traumatic brain injuries (TBI) are on the rise in the contemporary world, with dizziness being one of the symptoms of traumatic brain injuries. Growth in the incidence rate of dizziness linked with head and neck injuries is considerable, and otolaryngologists should be quite updated on how to diagnose and provide treatment for dizziness that is competitive with traumatic brain damage.[27]

The present research was conducted to investigate the prevalence of BPPV among individuals with mTBI and the effectiveness of the Canal Repositioning Procedure in treating BPPV among individuals with mTBI. To achieve the objective, 100 patients with mild traumatic brain injury who had undergone comprehensive clinical and ENT examination, and GCS scores were between 13 and 15, with written informed consent, were enrolled to partake in this study.

Of the total 100 patients, 87 male and 13 were female patients who reported mTBI, in the first 48 hours to 7 days of the study. The Department of Otorhinolaryngology of a tertiary care centre was used to recruit patients of mTBI.

Like our study, Suarez et al. studied individuals aged 19-78 years, and the age of the largest number of mTBI patients was less than 40 years.[28] The study by Haripriya et al. was carried out in the 10–70 year age groups, and the most affected group in their research was patients aged 41-50 years. They also indicated that among the total patients, 89 were male and 39 were female.[27]

Just as in our research (Geda et al.), where 156 males and 64 female mTBI patients were included, Ernst et al,[26] used 11 males and 52 female mTBI patients (conversely).

Symptom resolution and recurrence were assessed in the current research using the Dix-Hallpike Test (DHT) administered at baseline and at follow-ups. In the first evaluation (3-7 days after the injury), 19 patients were positive. All positive patients underwent the Epley maneuver. The resolution of symptoms was demonstrated by follow-up measurements at 2, 4, and 6 weeks after Epley maneuver. At the 2-week follow-up, 14 (73.6%) patients had resolved their symptoms and reported no recurrence. They rose to 17 (89.4) patients at the 4-week resolution rates. At 6 weeks, full symptom resolution (100) was observed in all victims, and no relapse occurred during follow-up.

Consequently, with respect to our investigation, Yacovino et al. indicated that BPPV signs in 86.4% of patients decreased following the single canal repositioning maneuver (Epley Maneuver) and that the remaining patients were symptom-free of BPPV following the repetitive canal repositioning maneuver.[29]

The same researchers, Korczyńska et al., reported that a 2-week follow-up resolved the symptoms of BPPV in 56.6% of patients, and 44.4% had successfully undergone repeated maneuvers at the 4-week follow-up. All patients were free of BPPV symptoms. The authors performed the Epley maneuver, which led to subsequent symptom alleviation. Researchers theorized that BPPV can be properly diagnosed and efficiently treated in mTBI patients without additional medication, surgical intervention, or special equipment.[18]

In the literature, an article by Power et al. showed results similar to ours and reported that, with 79% of patients, by one canal repositioning maneuver, and 91% by two maneuvers, the disorder symptoms ceased. The Epley Maneuver was selected as the canal repositioning maneuver in Posterior canal BPPV patients.[30] According to Motin et al., in the literature, 60% of patients with posterior canal BPPV had their symptoms of positional nystagmus and vertigo disappear after a single Particle

Repositioning Manoeuvre (PRM). Incomplete relief of the symptoms and signs necessitated fewer, three to six, subsequent sessions of treatment by the remaining 40 percent of patients. The authors proposed that physical maneuvers are effective in managing BPVV patients and improving rehabilitation outcomes.[20]

These results imply a gradual and clear improvement in BPPV symptoms with the Epley maneuver, with a vast majority improving by week 2 and all by week 6. The lack of recurrence throughout the follow-up period argued in favour of the efficiency of the manoeuvre (Epley) that was used with the BPPV patients, after mTBI. In general, we cannot find out that the BPPV in the posterior canals among patients with mTBI is a permanent and untreatable disorder. A premeditated clinical strategy, including the initial diagnosis with the Dix-Hallpike test and immediate treatment with the Epley maneuver, resulted in the elimination of symptoms in both the short- and long-term periods. The maximum number of patients have recorded a decline in symptoms by 2 weeks, and all patients by 6 weeks, with no return of symptoms. The results of this study indicate that the canalith repositioning procedure is effective for the management of BPPV associated with mTBI.

Conclusion

Canal Repositioning Procedure is a safe, non-invasive, and extremely effective method of treatment of BPPV related to mild traumatic brain injury. Early Dix-Hallpike and prompt CRP application are strong predictors of recovery, reduce morbidity, and improve patient outcomes.

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Conflicts of interest

There are no conflicts of interest.

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