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Brachial Plexus Injury and Benign Paroxysmal Positional Vertigo Following a Fall: A Case Report

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BRACHIAL PLEXUS INJURY AND BENIGN PAROXYSMAL POSITIONAL VERTIGO FOLLOWING A FALL. A CASE REPORT.

By

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ABSTRACT:

Background: In the elderly population, research has shown that impairments of balance and strength are common reasons for falls. Falls constitute one of the main reasons for emergency department and hospital admissions, and are the second most common reason for brachial plexus injury. Another common symptom, after a fall and head trauma incident, is Benign Paroxysmal Positional Vertigo (BPPV). Approximately 50% of subjects with traumatic brain injury complain about positional vertigo. Research shows that traumatic BPPV is commonly misdiagnosed in clinical practice.

Purpose: The purpose of this case report is to present interventions that were used to treat a patient with diagnoses of BPPV and brachial plexus injury following a fall.

Case Description: The patient was a 67-year-old white male who presented to therapy with complaints of dizziness and shoulder weakness after a fall. He was referred to physical therapy by his physician with a diagnosis of brachial plexus injury and suspected BPPV.

Outcomes: The dizziness symptoms associated with suspected BPPV were fully eliminated during the episode of care. The patient did not fully recover from the brachial plexus injury; however, he significantly improved his ability to perform activities of daily living.

Discussion: Symptoms of BPPV sustained during a traumatic fall were effectively diagnosed by the Dix-Hallpike test and were successfully treated by the Epley canalith repositioning maneuver. Furthermore, the physical therapy treatment formed by neuromuscular re-education, strengthening and functional exercises, seemed to have a positive impact on patient's recovery process following traumatic brachial plexus injury.

INTRODUCTION:

In older adults, falls are the leading cause of injury requiring admission to the emergency department or hospital and can sometimes be fatal.[1,2] Brachial plexus injury and dizziness associated with Benign Paroxysmal Positional Vertigo (BPPV) are common results of trauma related falls.[2,3] A significant amount of evidence describes treating patients with a single diagnosis of brachial plexus injury or BPPV; however, there is a gap in literature regarding the treatment strategy and progress of patients with multiple comorbidities. The purpose of this case report is to present the clinical reasoning and intervention strategy used by the physical therapy team during an eight-week treatment episode for a patient with comorbid BPPV and brachial plexus injury following a fall. The secondary purpose of this study is to report the patient's response to the implemented treatment.

CASE DESCRIPTION:

The patient was a 67-year-old white male who presented to therapy with complaints of dizziness after falling down the stairs at home and hitting his head about two weeks prior. He was admitted to the hospital one week after the incident. After hospitalization, he was referred to physical therapy by his physician with a diagnosis of brachial plexus injury and suspected Benign Paroxysmal Positional Vertigo (BPPV). The patient was a right hand

dominant barber who lived at home with his wife and was previously independent in work and all activities of daily living (ADLs).

During the initial evaluation, the patient reported experiencing a "spinning" sensation when getting out of bed, looking up, or bending over. In the affected right ® arm, he denied paresthesia, but reported pain and weakness that limited raising his arm and impeded instrumental ADLs (IADLs) such as dressing and tooth brushing, and work activities such as cutting hair.

Past medical history: The patient was previously diagnosed with prostate cancer, for which he was being treated for concurrently with physical therapy.

Patient/family goals: The patient's goals for physical therapy included decreasing the dizziness episodes, improving active range of motion (AROM), and strengthening of his right shoulder in order to be independent in all activities he was able to perform prior to the accident.

CLINICAL IMPRESSION:

From the data collected during initial interview and from the review of clinical records, it was hypothesized that the dizziness symptoms were associated with BPPV and the impaired function of the right shoulder was due to brachial plexus injury, both resulted from the blunt trauma to the

head and shoulder during the fall. A study performed by Liu[3] suggests that BPPV is a common symptom after a head trauma. According to the author, approximately 50% of the subjects with traumatic brain injury complained about positional vertigo.[3] Research performed by Thatte et al.[4] reported that the most common cause of brachial plexus injury in adults is motor vehicles accidents, with falls as the second or third most common cause of the trauma to the brachial plexus.[2,4]

EXAMINATION:

To examine the patient's impairments and confirm the diagnosis of BPPV, the Dix-Hallpike test was used, as is supported in the research[1]. The appropriateness of this test[1] and its excellent specificity of 100%[5] have been confirmed in the research.[5] If the test is positive, this population of patients with BPPV can be effectively treated by a special canalith repositioning maneuver.[3]

To assess the limits of the patient's right shoulder AROM, the standard 12-inch goniometer and measurement procedure as explained by Mullaney et al.[6] were used. This study reported a high intra-tester, intra-class correlation coefficient (ICC) between goniometer and digital level, ranging from 0.91 to 0.99, which confirms that a goniometer is a reliable tool to measure patient's shoulder range of motion.[6]

The manual muscle test (MMT) techniques, as explained in Hislop & Montgomery,[7] were used to evaluate the patient's bilateral upper extremity (UE) strength. The MMTs and AROM assessments were both performed with the patient in standing position. Before beginning the initial assessment, the patient completed the Disability of Arm, Shoulder and Hand (DASH) questionnaire. According to a study performed by Roy JS et al., the DASH reports an intraclass correlation coefficient (ICC) of 0.77–0.98, standard error of the measure (SEM) of 2.8–5.2, a minimal clinically important difference (MCID) of 10.2 and a minimal detectable change (MDC) of 6.6–12.2.[8] Assessment of the patient's posture alignment revealed a forward head posture in sitting and standing positions. A summary of the examination data is shown in Tables 1 and 2.

Table #1: Initial neurological examination data.

Dix-Hallpike test	Right side	Left side
Results	(+) Positive mild UBN	(+) Positive severe UBN

UBN: Upward Beating Nystagmu

Table #2: Initial examination data.

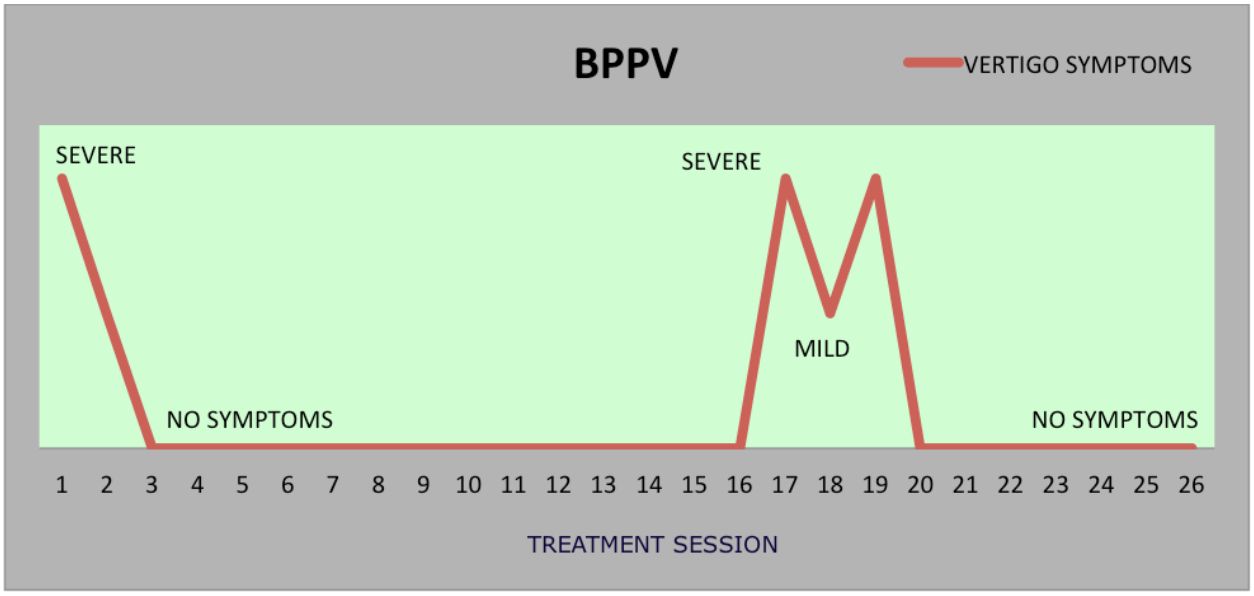
Tests	DASH score	R shoulder AROM				R shoulder MMT		
		Flex	Abd	IR	ER	Flex.	Abd.	ER
Initial evaluation	50%	15°	10°	HUB: R buttock	Not tested	2/5	2/5	1/5

DASH The Disability of Arm Shoulder and Hand; AROM active range of motion; MMT manual muscle test; Flex Flexion; Abd Abduction; IR internal rotation; ER external rotation; HUB hand up back.

INTERVENTION:

The patient attended 60-90 minute physical therapy sessions 2-3 times a week for 8 weeks, equaling a total of 26 therapy sessions. During the first two sessions, the patient primarily received treatment for his BPPV symptoms. Each session, the Epley canalith repositioning maneuver was performed three times, exclusively for his left side due to fact that upward beating nystagmus (UBN) was most severe during left Dix-Hallpike test. It was suspected that, posterior semi-circular canal of patient's left inner ear was involved.[9] Before each intervention, the specific steps of the maneuver were explained and reviewed with the patient. After these sessions, the patient was instructed to stay in upright position and avoid bending forward or lying down on his left side for at least 24 hours, if possible. After the first therapy session, the patient reported that the dizziness symptoms significantly decreased. After the second physical therapy session, the symptoms were fully eliminated on both sides. However, the BPPV symptom resumed after 6 weeks, the Dix-Hallpike test was also performed at this time to confirm the diagnosis. At this point, the Epley maneuver was repeated 3 times on the left side for one session and 3 times on his right side during the following session. The patient was also given instructions on how to perform the Epley maneuver on his own if the symptoms returned. After those two sessions, the dizziness symptoms had stopped, and the patient remained clear of BPPV symptoms until discharge (Fig 1).

Figure 1: Progress of the BPPV symptoms.



During the third session, the intervention for patient's right shoulder was implemented. Initially the shoulder intervention focused on active assisted range of motion (AAROM) exercises, specifically, pulleys and finger ladder 10-15 min for each exercise (appendix A), active range of motion (AROM) exercises, specifically, wall washes and table washes, 7-15 minutes each exercise (appendix A), and upper body ergometer exercises, level 1 for 10 min. After the second week, more progressive resisted exercises concentrating on the eccentric work of the shoulder and parascapular muscles were implemented, specifically, wrist ripper with 2 lb. weight and Thera Bands® (appendix A). All of the exercises were adjusted to the patient's progress by increasing resistance and number of repetitions

throughout the treatment. During week six, proprioceptive neuromuscular facilitation (PNF) strengthening exercises were added to the program (diagonal D1 flexion, extension, diagonal D2 flexion, extension). Initially, these exercises were performed without resistance, then progressed with yellow Thera bands®. A research study performed by Sullivan et al. tested activity of the shoulder muscles during unilateral upper extremity PNF patterns using electromyography (EMG). The study confirmed that the intended shoulder muscles were active during these PNF patterns.[10]

During the last phase of the plan of care, more functional activities were added. For example, patient performed activities such as placing and retrieving objects from a shelf at shoulder-height and above-shoulder. Due to specificity of the clinic specialized in mechanical diagnosis and therapy (McKenzie), retraction-extension exercise was used to improve patient's sitting and standing posture during each therapy session. The patient performed retraction-extension exercise for his cervical spine about 7-15 minutes each session. The patient was also instructed to perform his home exercise program (HEP) daily, three times per day. His HEP included 3 sets of 10 repetitions for each exercise: cervical retraction-extension, pulleys, wall washes, hand up back with belt, and table washes (appendix A). Later, the PNF strengthening exercises were also added.[10] All of the therapy interventions and the week they were performed are presented in Table 3

Table 3: Interventions.

Intervention	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1	X	X	X	X	X	X	X	X
2	X					X		
3	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X
6		X	X	X	X	X	X	X
7			X	X	X	X	X	X
8			X	X	X	X	X	X
9						X	X	X
10							X	X

1= patient education
2= Epley maneuver
3= range of motion exercise
4= active assisted range of motion
5= upper body ergometer
6= neuromuscular re-education
7= active range of motion
8= progressive resistive exercise
9= proprioceptive neuromuscular facilitation
10= functional training

OUTCOMES:

The subject of this case report can be considered a complex patient due to his vestibular, neuromuscular, and endocrine system diagnoses as well as other comorbidities. Recovery process for brachial plexus injury is often incomplete and expected to take 6 to 18 months.[11] During this episode of care, the patient showed progress in his shoulder ROM and strength with some deviations in his status. For example during week 5, the AROM of patient's involved shoulder decreased from 65° to 33° (Fig 2). The deviations were probably caused by return of his BPPV symptoms and clinical procedures associated with the patient's cancer diagnosis and

treatment. At the end of week 8 of physical therapy, patient's right shoulder ROM and strength were not within normal limits (WNL) yet, however, had significantly improved. In addition, his AROM improved from 15° to 74° of shoulder flexion, 10° to 64° of shoulder abduction, and in strength from 1/5 to 3/5 of shoulder external rotation since patient begun receiving physical therapy care (Fig 2 and Table 4). Overall, the patient presented with enhancement in his functional abilities. At the completion of the treatment, patient was able to perform ADLs and IADLs independently, such as washing his hair, brushing his teeth, donning and doffing a T-shirt, and placing and retrieving a 1 lb. dumbbell from an overhead shelf. Moreover, the dizziness symptoms associated with BPPV were fully eliminated by week 7 of treatment. At discharge, the patient reported that he was feeling at least 50% better since he started physical therapy treatment. However, the DASH score did not reflect this progress. At discharge, the DASH score was 10% worse than during the initial evaluation and changed from 50 to 55%. All the outcomes measures and data collected during this episode of care are provided in Table 4.

DISCUSSION:

The purpose of this case report is to present interventions that were used to treat a 67-year-old white male with diagnoses of BPPV and brachial

plexus injury following a fall. The patient attended 26 therapy sessions,

Table 4: Outcomes

Tests	DASH score	R shoulder AROM				R shoulder MMT				Pain on VAS
		Flex	Abd	IR	ER	Flex	Abd	ER	IR	
Normal values	0%	180°	180°	90°	90°	5/5	5/5	5/5	5/5	0/10
Initial evaluation	50%	15°	10°	HUB: R buttock		2/5	2/5	1/5		3/10
Week 3		65°		40°		3/5	3/5	2-/5	2-/5	
Week 5		33°	36°	HUB: R L4		2+/5	2+/5	3/5	2+/5	3/10 end range
Week 6		64°	60°	25°	15°					
Week 8	55%	74°	62°			3/5	2+/5	3/5	3/5	

DASH The Disability of Arm Shoulder and Hand; AROM active range of motion; MMT manual muscle test; Flex Flexion; Abd Abduction; IR internal rotation; ER external rotation; HUB hand up back.

Figure 2: Progress of right shoulder AROM

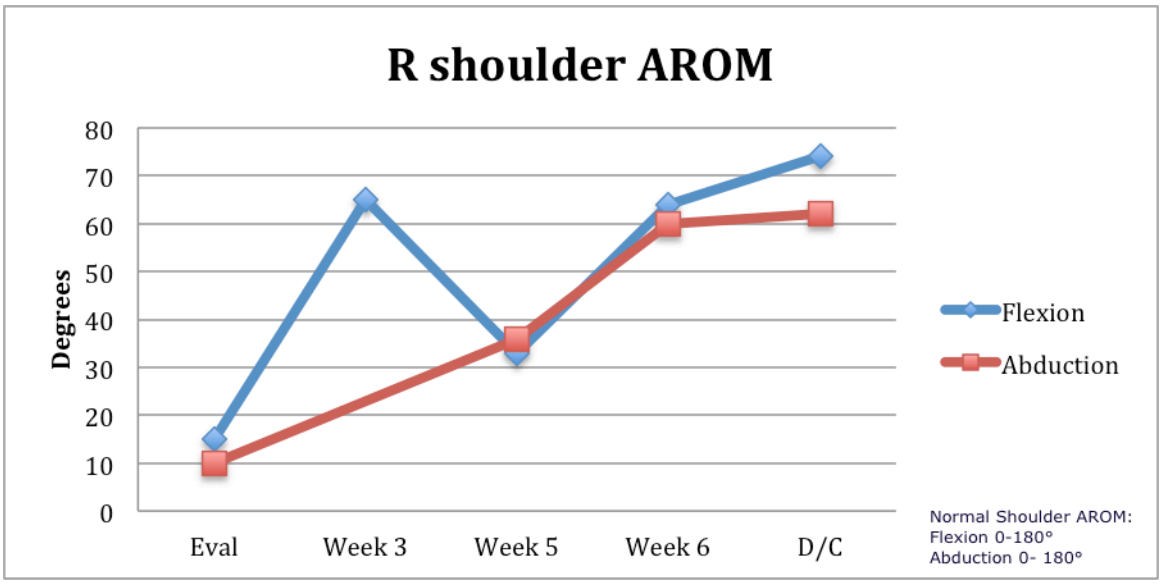
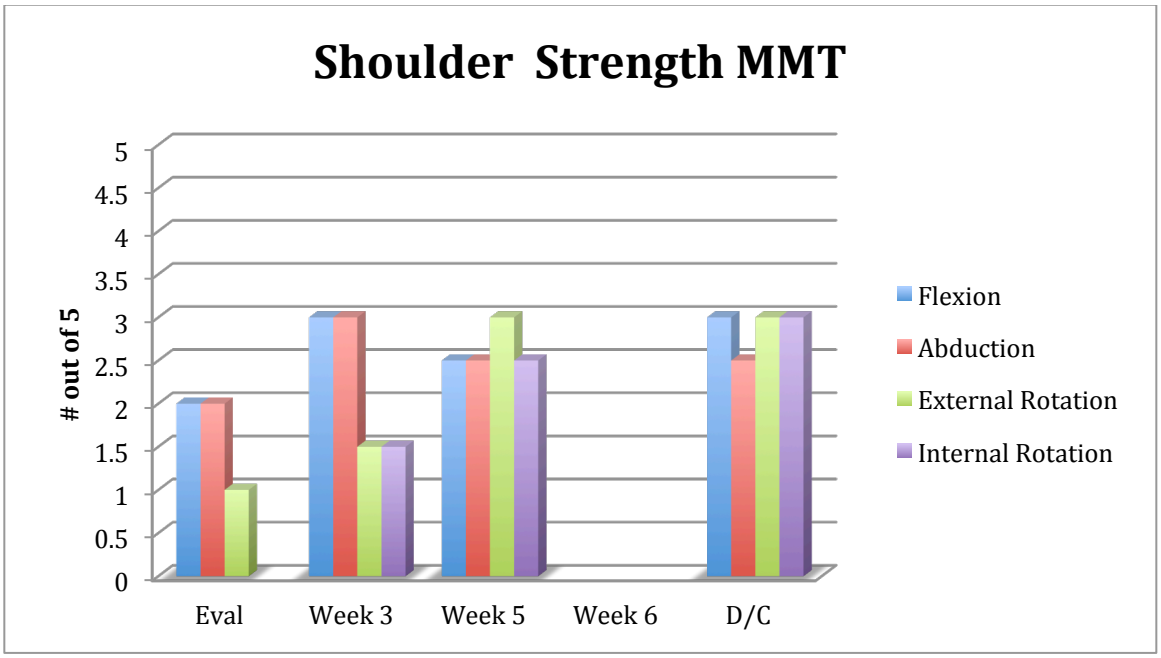


Figure 3: Progress of right shoulder muscle strength



MMT: Manual muscle strength, #1.5=MMT 2-/5, #2=MMT 2/5, #2.5=MMT 2+/5, #3=MMT 3/3.

which were concentrated mostly on the Epley canalith repositioning maneuver to decrease BPPV symptoms, neuromuscular re-education, therapeutic exercises and activities to improve AROM and muscle strength of his R shoulder. At discharge, patient presented with improved shoulder AROM an ability to perform ADLs.

It is expected that the complexity of the subject associated with his comorbid diagnoses mentioned earlier had some impact on his recovery process. The cancer treatment, concurrent to physical therapy plan of care, seemed to have some impact on the patient's progress. During the fifth week of therapy, the patient underwent a lumbar procedure (spinal tap) as

part of his cancer treatment. The physician suggested the patient rest and lay down for an entire day after the procedure. Two days after this procedure, the patient presented to therapy with some decrease in right shoulder muscle strength and endurance from 3/5 to 2+/5, which also reflects as decreased shoulder flexion. Moreover, reappearance of the Benign Paroxysmal Positional Vertigo symptoms during the 6th week of the therapy, also had impact on the patient's status. According to Mokri et al.[12] volume depletion of the cerebrospinal fluid (CSF) caused by CSF leak or by spinal tap diagnostic procedure, can cause descent of the brain, at the same time changing pressure in the perilymphatic fluid of the inner ear. In this situation altered hearing or vertigo symptoms can be present.[12]

During episodes of vertigo and after the "spinal tap" procedure, the patient was unable to perform his home exercise program. Throughout these episodes, the patient spent most of the time in bed, which could be a reason why his progress in the therapy (AROM, strength and muscle endurance) fluctuated. However, at the end of the therapy care (26 visits), the patient reached all of his anticipated goals. He presented with significant improvements in AROM, strength, and muscle endurance, which reflected in his ability to perform all previous ADLs.

Conversely, the meaningful improvement in the patient's ability to perform ADLs was not reflected in the patient's DASH score. It could not be explained why the initial evaluation score was better than discharge score. It

could only be hypothesized that the patient did not fully understand the instructions of the DASH questionnaire. Possibly he did not chose the most appropriate answers when completing the questionnaire, especially since, during the discharge assessment, he stated that his overall status and ability to perform ADLs had improved at least 50% since the beginning of the physical therapy.

This case report supports the previous research evidence presented by Liu H.[3] that BPPV sustained during a traumatic fall can effectively be diagnosed by the Dix-Hallpike test and can successfully be treated by the Epley canalith repositioning maneuver. Moreover, this case report supports the clinical reasoning and appropriateness of the intervention used in this study to treat the patient with a post fall brachial plexus injury. Similar to the study published by Chambers et al.,[11] this study confirmed that recovery of a brachial plexus injury is a lengthy process. The eight weeks of physical therapy was not sufficient to reach a full recovery; however, it represented satisfactory amount of time to improve patient's ability to perform ADLs. Furthermore, the length of treatment provided adequate time to educate the patient on how to advance his HEP in order to further improve his skills and progress toward full recovery after discharge.

Limitations of the study: Due to the specificity of a case report, only a single subject's response to the interventions was presented. Therefore, these

findings cannot be generalized to other populations. More research is needed to confirm or refute these interventions as the best plan of care for BPPV, brachial plexus injury and symptom presentation.

Conclusion: This case report presents one incidence of BPPV and brachial plexus injury as a result of fall. The physical therapy interventions presented in this study were effective for both BPPV and brachial plexus injury. Moreover, strategy used in this case report confirms that it is appropriate to resolve the BPPV first before addressing other issues such as brachial plexus injury. The current study presents the recovery process during 8 weeks episode of physical therapy. There is need for further study and follow-up, possibly after 6, 12 and 18 months, to monitor patient status in the process to recovery.

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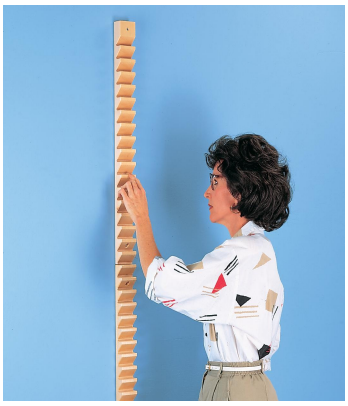
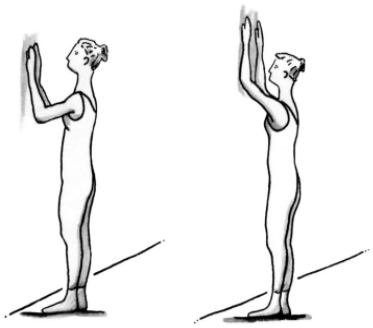
Appendix A: Therapeutic exercises.

1. Finger ladder [13]



2. Pulleys [14]

3. Wall washes [15]



Thera band ®[16]

5. Wrist ripper:[17]