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Developmental, Gait, and Balance Training in an Individual with a Vertebral Artery Dissection: A Case Report

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Abstract

Background: A vertebral artery dissection occurs when there is a flap-like tear in the vertebral artery. Blood quickly enters between the intima and media, and the blood coagulates, leading to an occlusion or stenosis. As a result, a vertebral artery dissection can cause an ischemic stroke in the cerebellum, brainstem, or spinal cord. The purpose of this case report is to present an inpatient rehabilitation plan of care for a patient suffering from a vertebral artery dissection and provide meaningful evidence-based information. **Case Description:** This case report focuses on a 31 year old female who injured her neck during a workout and subsequently visited the chiropractor. A few days later, she was admitted to the ER for headaches and vertigo. She was diagnosed with a vertebral artery dissection that resulted in a basilar artery thrombosis and stroke involving the bilateral cerebellum and the left paramedian pontine. **Intervention:** The focus revolved around the progression from neurodevelopmental and pre-gait tasks to gait, dynamic balance training, and functional tasks. Neurodevelopmental tasks focused on core stabilization and postural alignment in seated, quadruped, tall kneeling, and half-kneeling positions. **Assessments:** The primary outcomes throughout the plan of care were gait and balance based. The primary ones utilized were the amount of assistance, distance walked, Timed Up and Go Test, the Berg Balance Scale, and the Functional Independence Measure. **Discussion:** The mechanism of injury is something to take note of during the evaluation, as research has shown certain predisposing activities for a potential vertebral artery dissection. Interventions should revolve around breaking down the stages of gait into its simplistic feature, with a focus on facilitating normal postural alignment and movement patterns, and also regaining balance.

Background

The vertebral artery consists of 3 layers: the intima, the media, and the adventitia. A dissection in the vertebral artery occurs when there is a compromise in the structural integrity of the arterial wall, most notably seen as a small, flap-like tear (Britt and Bhimji, 2017). When there is a small, flap-like tear in the intima, this results in arterial blood to dissect between the layers of the arterial wall. The blood within the arterial wall then coagulates and a clot is formed. If large enough, the clot obstructs arterial blood flow leading to leading to stenosis. The compromised blood flow that results from the stenosis leads to the symptoms that come with a vertebral artery dissection, and ultimately, stroke. Vertebral artery dissections are classified as either intracranial or extracranial. Intracranial dissections carry a worse prognosis than extracranial dissections. In intracranial dissections, it is often associated with a subarachnoid hemorrhage. Extracranial dissections oftentimes involve the extracranial segment near the atlas and axis (Britt and Bhimji, 2017).

The clinical presentation of vertebral artery dissections are typically acute in nature with severe unilateral neck pain and a headache. The pain in the neck is most commonly located in the occipital and cervical region. Neurological symptoms may or may not be present, and when they are present, they are oftentimes delayed. If there are neurological symptoms due to a stroke, the two most common locations for infarctions are in the cerebellum or the lateral medulla (Britt and Bhimji, 2017). If the delayed neurological symptoms are in fact present, the main symptoms seen are vertigo, dizziness, ataxia, dysarthria, and diplopia. There are several events that predispose individuals for a vertebral artery dissection. Some events include coughing, vomiting, chiropractic procedures, and blunt trauma. The most common precipitating event is some sort of blunt trauma to the neck region. Research has found that approximately 1 out of every 20,000 cervical spine manipulations can cause a vertebral artery dissection (Britt and Bhimji, 2017). In addition, individuals with Ehlers-Danlos syndrome are at an increased risk.

A vertebral artery dissection is an infrequent and often misdiagnosed cause of stroke. It is believed to be the cause of approximately 2% of all ischemic strokes (Migliaccio and Lindquist, 2017). However, there is an increased frequency in the younger population, with vertebral artery dissections being responsible for approximately 40% of strokes for individuals under the age of 45. The purpose of this care report is to create awareness on signs of a potential vertebral artery dissection based on the mechanism of injury and signs and symptoms present. Additionally, this serves to present an inpatient rehabilitation plan of care for a patient suffering from a vertebral artery dissection, providing meaning evidence-based information guided by stroke rehabilitation principles.

Case Description

The patient was a 31-year-old female who was admitted to Allen Memorial Hospital Inpatient Rehabilitation unit in early June of 2017 following a vertebral artery dissection one week prior to admission. She was working out at her local gym, focusing on shoulder strengthening with dumbbells, when she noticed neck discomfort. After a week of her neck not improving, she went to see a chiropractor, in which the chiropractor performed some neck manipulations. A few days following her chiropractor visit, she was admitted to the emergency room for symptoms of vertigo and headaches. She was treated for the vertigo and headaches and was released to go home for the night. As she was walking out of the hospital to her car, she began to experience vertigo once again, and was readmitted. Upon further testing, the doctors diagnosed her with a vertebral artery dissection that resulted in a basilar artery thrombosis and stroke involving the bilateral cerebellum and the left paramedian pontine. At the time of the initial evaluation, the primary complaints were diplopia and posterior head pain ranging from 6-8/10 on a pain scale. The patient's past medical history was unremarkable with no reported episodes of vertigo. She is married with a 1-year-old and a 3-year-old, stating that

her main goal was to be able to go home to her children and husband, and to be able lift up and play with her children.

Upon evaluation, the patient was sitting up in the bedside chair in her room. She was alert and oriented to the person, time, and place. In the bedside chair, various coordination tasks were assessed. The first was the finger-nose-finger test. The right upper extremity was severely impaired with past pointing and was completed with inconsistency and decreased speed in comparison to the left upper extremity. Next, rapid alternating movements was used to test upper extremity coordination. Her right upper extremity was impaired again with decreased speed in comparison to the left upper extremity and she was unable to achieve full supination of the right forearm. Knee to shin was used to assess the coordination of the lower extremities. Ideally, the knee to shin should be assessed in the supine position, but due to the patient already being up in the seated position, this was the position in which the test was performed. Once again, the right side of the body was the most impaired. She displayed decreased control and dysmetria with the right lower extremity, with less profound findings on the left lower extremity. After testing her upper and lower extremity coordination, her range of motion and strength was assessed. All her range of motion and strength tested out as within functional limits for both upper and lower extremities. When assessing gait, she required use of a front wheeled walker and moderate assist x2 for both walking and for control of the walker. She displayed a very narrow base of support, bilateral trunk sway, scissoring of her right lower extremity, and her right lower extremity was ataxic. Sit to stand and stand to sit transfers also required moderate assist x2. The evaluation and examination showed that coordination deficits of her right upper and lower extremities and lack of pelvic control were directly the result of the vertebral artery dissection affecting her cerebellum.

Interventions

Based upon the initial evaluation and the goals the patient had set for herself on discharge, the plan of care revolved around trying to gain back coordination, normalize her gait, improve her balance, and incorporate functional tasks. In order to do so, we had to take a step back and buildup a progression. Over the course of her 4-week stay in inpatient rehab, we progressed from neurodevelopmental and pre-gait tasks in the parallel bars to gait, dynamic balance training, and functional tasks. The neurodevelopmental tasks were completed in seated, quadruped, tall kneeling, and half-kneeling positions. This focused on core stabilization and postural control as she presented with severe truncal ataxia during gait. To initiate, the first task was to get her to sit upright without leaning to her left side and to work on anterior and posterior pelvic tilts in order to restore normal mobility of the pelvis. This took maximum tactile cueing. Placing a mirror in front of her proved to be a useful visual cueing to get her to understand where neutral positioning actually was and how it feels to maintain that position.

PNF patterns, including rhythmic stabilization and alternating isometrics, were applied to the anterior and posterior shoulders and hips to enhance core stability and to restore truncal control. This was done in the quadruped, tall kneeling, and half-kneeling positions. We did not progress into tall kneeling and half-kneeling until she was able to hold pelvic and core in proper alignment in quadruped against light resistance for 2-3 seconds. In addition to rhythmic stabilization and alternating isometrics in quadruped, anterior-posterior weight shifts were performed as well as lifting one extremity at a time while maintaining a neutral pelvis. The reciprocal pattern of opposite arm and opposite leg was introduced while crawling, and she required moderate tactile cueing and compression of the pelvis to maintain pelvic control.

Pre-gait tasks were completed in the parallel bars. These tasks included anterior-posterior and medial-lateral weight shifts with feet together and in split stance. The big focus with the weight shifts was smooth and controlled motions and coming forward up on to the toes and back on to the heels with the anterior-posterior weight shifts. After weight shifts, we added in a forward step with the shift in weight, followed by a step back. This required maximal

compression of the pelvis to maintain trunk control and also blocking of the right knee to prevent collapsing. The final step of pre-gait was putting the whole gait sequence together in the parallel bars. The biggest improvements in gait began when the headaches and double vision went away and were no longer an inhibiting factor. This took around 2 weeks to diminish and finally resolve. As we progressed through the treatment, she felt more comfortable going without an assistive device. As the pelvic and truncal control improved, so did the rest of the gait pattern.

After approximately 2 weeks of intensive neurodevelopmental and pre-gait tasks, she was ready to progress to dynamic balance training and functional tasks. Dynamic balance started inside the parallel bars for the first 2-3 days. Balance tasks included toe tapping various cones, marches, tandem walking, retro-walking, side steps, step ups, stepping over objects. Once she was able to perform these tasks comfortably inside the parallel bars, they were performed outside the parallel bars without upper extremity support. Initially outside the parallel bars, contact guard assist was required for safety, and she was able to progress to supervision the final week. Functional tasks including vacuuming and sweeping the floor, grabbing and putting away dishes from cupboards, and picking up weights and setting on her lap. The main focus of cleaning the floor and grabbing dishes from cupboards was to get her to reach and use her right upper extremity. This worked her balance as well as her coordination of her right upper extremity. The first time cleaning the floor, she kept the vacuum and broom close to her body, not trusting her balance outside of her center of mass to reach out with her right arm. With proper cueing, she was able to extend her right arm out in front of her body while maintaining her balance and return the vacuum back to her body. Picking up weights help simulate reaching for her children. The weights were placed at various heights and at varying positions in relation to her body. The tasks were performed in both sitting and standing positions, requiring her to bend, twist, and reach to simulate picking up her children.

Assessments

Multiple assessments were utilized throughout the plan of care to gauge how this patient progressed from the initial evaluation to the discharge date. These included the Functional Independence Measure, Berg Balance Assessment, Timed Up and Go test, and quality of gait. The gold standard assessment for inpatient rehabilitation is the Functional Independence Measure, or FIM. The FIM is an 18-item tool measuring functional disability of individuals in terms of need for assistance. 13 items fall under motor function and each item is scored from 1 to 7, with 1 being total dependence and 7 being total independence. At Allen Memorial Hospital, the physical therapists focus solely on the motor tasks. On admission, the patient required maximum assistance to moderate assistance for nearly all tasks. Her total FIM score was 36 out of a possible 91. On discharge, the patient drastically improved her total FIM motor function tasks, scoring 85 out of the possible 91. At time of discharge, supervision was the lowest marking, and that was for stair ambulation. She was completely independent with most tasks, and modified independent for ambulation and transfers without an assistive device.

Particularly for strokes, the FIM is a great tool for predicting the discharge outcome. According to a meta-analysis, the admission score of the FIM motor portion has the greatest effect on a patient's length of stay in inpatient rehabilitation, with a 10 day difference between those scoring in the 10^{th} percentile versus those in the 90^{th} percentile (Brown et al, 2015). In addition, the FIM motor score on admission had an effect on the outcome of discharging to home. The probability of discharging home is 75% for those scoring in the 50^{th} percentile.

The next assessment tool used for this case was the Berg Balance Assessment. This was first assessed 2 weeks into the treatment timeline, and she scored a 30 out of 56, which classified her in the medium fall risk category. Two weeks later, on the final week before discharge, her Berg Balance score increased to 44/56, which classified her on the low end of the low fall risk category. In general, a difference in 8 points is required to show a genuine change in function between two assessments. Research has shown the minimal detectable

change for the Berg Balance Assessment for individuals affected by a stroke is 6 points for there to be 90 percent confidence of genuine change (Stevenson, 2001). Therefore, this patient made considerable improvements in her balance from the first time she was assessed to her final time.

The Timed Up and Go Test (TUG) is a highly recommended assessment tool for individuals suffering from a chronic stroke. Although this patient was still in the acute phase during her stay, it was felt this was still an important evaluation in terms of fall risk and progression of gait through the rehabilitation process. To get a baseline on the TUG, this was initially performed during the first week of her stay. She completed the task in 27 seconds with a FWW and moderate assist x2 with one therapist to help control the walker and the second to stabilize the hips. By discharge day, she was able to complete the TUG in 12 seconds without use of an assistive device and supervision. Although gait deviations were still present, the amount of improvement displayed in the TUG going from a FWW and moderate assist x2 in 27 seconds, was profound. Research has shown the minimal detectable change to be 2.9 seconds for chronic stroke, with a recommendation of at least 7 days between assessments (Andersson et al, 2006). There is no cutoff score established that indicates the risk of falls in the younger stroke population, but for older stroke patients, the cutoff is 14 seconds (Flansbjer et al, 2005).

The final assessment tool utilized was the quality of walking, which includes both the amount of assistance required and the distance covered. There is not a quantitative way to document the progress made throughout the treatment sessions in regards to quality of gait other than descriptions of how she presents while ambulating. As described in the case description above, the quality of gait at the time of the initial evaluation was poor. She was only able to walk 10-15 feet at a time with a very narrow base of support, bilateral trunk sway, scissoring of her right lower extremity, and her right lower extremity was ataxic. All of this while requiring a FWW and moderate assist x2 to complete. Through the course of treatment with the interventions previously described, we were able to wean away from assistive devices altogether, her base of support and trunk control became more normalized, and she was able to walk over 300 feet with modified independence. Although she never got back to a completely normalized gait pattern at the time of discharge, she had shown enough improvement since the initial evaluation that it was appropriate to discharge her home and for her to continue receiving further treatment in an outpatient setting.

Discussion

There is research provided in the literature that supports the use of trunk stabilization in patients suffering from truncal ataxia. The idea behind this intervention is to improve the muscular control that is needed to stabilize the trunk against internal and external forces associated with activities of daily living. Utilizing PNF and rhythmic stabilization techniques has been shown to be a particular intervention to enhance trunk stability (Kim et al, 2011). One of the ways it does so is by increasing muscle activation and strength of the involved limb's quadriceps, hamstrings, and soleus (Kim et al, 2011).

The descriptions of the interventions for this particular case is not a perfect rehab solution or the only route that can be taken to achieve desirable outcomes. Other interventions can be utilized that were not in this particular instance. An intervention idea that was not performed that could have proven to be beneficial for this patient is the use of the treadmill with body weight support to not only help with truncal ataxia, but also in overall gait improvements. Research has found that utilizing this intervention in conjunction with an over ground gait training regimen can be an effective way in the improvement of ambulatory function in individuals with severe cerebellar ataxia (Cernak et al, 2008). Although this research exists on the benefits of the use of a treadmill with body weight support, the intensity of the treatment and the time elapsed since the initial onset of injury remains inconclusive.

There are other assessment tools out there that can be utilized for the purposes of this case. One in particular, the International Cooperative Ataxia Rating Scale, or ICARS, is a way to quantify cerebellar symptoms present (Bultmann et al, 2014). This scale is scored from 0 to 100, with 0 being no ataxia and 100 being strongest ataxia. There are four main clinical core symptoms associated with this scale: posture and gait disturbances, kinetic function, speech disorders, and oculomotor disorders (Bultmann et al, 2014). For the purposes of this case study, looking at posture and gait disturbances and kinetic function would have been a sufficient assessment tool to perform at the time of the initial evaluation and at discharge. Allen Memorial Hospital did not have access, but utilizing a program that can analyze postural stability and postural sway during dynamic activity tasks would be another great assessment tool to see the progression of potential truncal ataxia.

When a patient comes into your care as a clinician, it is important to take note of the mechanism of injury. Even though vertebral artery dissections are not common, research has shown certain activities predisposing an individual to this. Pay close attention to any potential cerebellar signs during the evaluation, particularly truncal ataxia that has a negative impact on the quality of gait. This case report establishes interventions that can be used in an inpatient rehabilitation setting to set the patient up for success down the road post-discharge. Pelvic control and truncal stability is key. Interventions performed should focus on breaking down the stages of gait to focus on facilitating normal postural alignment and movement patterns. Once those get established, the attention can get turned to regaining balance and performing functional tasks that are relevant to the particular patient at hand.

References

1. Andersson AG, Kamwendo K, Seiger A, Appelros P. 2006. How to identify potential fallers in a stroke unit: validity indexes of 4 test methods. *Journal of Rehabilitation Medicine.* 38(3): 186-191.
2. Britt TB, Bhimji SS. 2017. Dissection, Vertebral Artery. *StatPearls Publishing*.
3. Brown AW, Therneau TM, Schultz BA, et al. 2015. Measure of functional independence dominates discharge outcome prediction after inpatient rehabilitation for stroke. *Stroke*. 46(4): 1038-1044.
4. Bultmann U, Pierscianek D, Gizewski E, et al. 2014. Functional recovery and rehabilitation of postural impairment and gait ataxia in patients with acute cerebellar stroke. *Gait and Posture*. 39(1): 563-569.
5. Cernak K, Stevens V, Price R, Shumway-Cook A. 2008. Locomotor training using body-weight support on a treadmill in conjunction with ongoing physical therapy in a child with severe cerebellar ataxia. *Physical Therapy*. 88(1): 88-97.
6. Flansbjer, U. B., Holmback, A. M., Downham D, Patten C, Lexell J. 2005. Reliability of gait performance tests in men and women with hemiparesis after stroke. *Journal of Rehabilitation Medicine*. 37(2): 75-82.
7. Kim Y, Kim E, Gong W. 2011. The effects of trunk stability exercise using PNF on the Functional Reach Test and muscle activities of stroke patients. *Journal of Physical Therapy Science*. 23: 699-702.
8. Migliaccio D, Lindquist B. 2017. A posterior circulation stroke presenting with isolated truncal ataxia. *Cureus*. 9(9): 1709.
9. Stevenson, TJ. 2001. Detecting change in patients with stroke using the Berg Balance Scale. *The Australian Journal of Physiotherapy*. 47(1): 29-38.