PHYSIOTHERAPEUTIC ASSESSMENT AND REHABILITATION STRATEGIES OF THE SEQUELAE OF SURGICAL REMOVAL IN A IV VENTRICULUM'S TUMOR: A CASE STUDY

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Abstract: Introduction: Tumor surgeries in the IV ventricle are challenging and hairsplitting due to the risk of injury in adjacent structures, such as, the cerebellum and vestibular nucleus, which can cause movement disorders, affecting balance and gait, resulting in a decrease in functional capacity and quality of life. Objectives: Find the most effective assessment and rehabilitation process, taking into account a whole bio-psycho-social that is the patient of this case study. Methodology: Subjective and objective assessment were performed, as well as a treatment plan to the patient in question. Results: Good results were recorded on the Berg Scale and Timed Up & Go (Tug). Discussion: A lot of literature talks about isolated treatments to treat sequelae of surgical procedures close to the cerebellum, however in this case study it is demonstrated that, supported by the existing scientific evidence, with the aid of clinical reasoning and critical thinking, it is possible to adapt and execute a assessment and rehabilitation process for those patients, in a safe and effective way. Conclusion: Physiotherapy, namely therapeutic massage, re-education of the gait pattern, namely facilitating the semi-step with handling in the foot, ankle and knee, balance training inspired by the Berg Scale, functional training with the promotion of dynamic instability and aerobic training, result in good strategies to decrease postural instability, maximize functional capacity and minimize complications in this kind of surgeries.

Keywords: physiotherapy, surgery, IV ventricle, ataxic gait, vestibular rehabilitation

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Introduction

Intraventricular tumors represent 2% of intracranial lesions , however, lesions of the fourth ventricle constitute only a small portion of these lesions (Ferguson S. et all , 2018). These tumors are found more frequently in the posterior portion of the lateral ventricles in pediatric cases, while in adults they are found more frequently in the IV ventricle, namely in the supra-tentorial zone (Koeller K. et all , 2002).

The IV ventricle is a pyramidal-shaped space that forms the cavity of the metencephalon and myelencephalon. The apex of this ventricle extends to the base of the cerebellum and tapers caudally into a narrow canal that continues into the cervical cord. Laterally, the fourth ventricle extends over the surface of the medulla as the lateral recess, to open in the area of the pons-bulb-cerebellum junction, the pons-cerebellum angle. Although the lateral recess is composed of the choroid plexus, the limits of this space are formed by cerebral structures, including the cerebellum, the superior cerebellar peduncles, and also the superior and medial vestibular nucleus (Haines D. et all , 2018).

Intraventricular lesions represent a great surgical challenge, since tumor surgery, particularly in the fourth ventricle, is quite detailed due to the proximity, and possible injury, of vascular structures, adjacent cranial nerve nuclei, cerebellar peduncles, vestibular nuclei and cerebellum. (Tomasello F. et all , 2015). The cerebellum plays an essential role in controlling limb movements, eye movements, balance and gait, varying with the extent and location of the lesion. Balance and gait deficits reflect the important role that the cerebellum plays in coordination, sensory integration, coordinate transformation, learning, and motor adaptation (Marsden , J., 2018). Cerebellar ataxia is a movement disorder that can affect balance, gait, limb movement, oculomotor control, as well as cognition and emotions. These symptoms significantly affect functional capacity and quality of life (Zhang L. et all , 2017). In a cohort study , it was reported that the most common sequelae in tumor surgery on the fourth ventricle were: headaches (45%), nausea and vomiting (38%), walking difficulties (33%), visual

changes (29%), dizziness (24%), cranial nerve deficits (16%), fatigue (13%), and memory impairment (11%). Several patients presented multiple symptoms, which is why the total does not give 100% (Ferguson S. et all , 2018).

The objective of this case study is to find the most effective evaluation and rehabilitation process, to maximize functional capacity and minimize secondary complications of surgical removal of a tumor in the IV ventricle, always taking into account the entire bio- psychological being . which is the patient in this study.

Methodology

Patient's story

After several episodes of forgetfulness, namely where he parked his car, in 2018 he underwent a Computerized Axial Tomography (CAT), where a tumor was detected in the IV ventricle, resulting in cranio-cerebellar surgery to remove that same tumor on the 3rd of October 2018, starting a first period of rehabilitation one and a half months after surgery lasting 3 months. On February 11, 2020, the patient says that she is forgetful, reports having changes in her vision and that when she turns her neck "she becomes confused/dizzy", falling frequently (2 to 3 times a day without severity so far), and that due to their imbalance they find it very difficult to carry out most of the activities of daily life (avd's). To perform these avd's he spends a lot of time on his knees, and when in an upright position and when walking, he needs a cane to support himself and move around outside the house, since, inside the house he says that his cane is the furniture.

Assessment

On February 11, 2020, the patient presented to the hospital with an ataxic gait assisted by a cane. The muscle test on the main muscle groups of the lower limb (mi) resulted in a 5, except for the

tibiotarsal dorsal flexors (tt) on the right side (drt) resulting in a 4+. Osteotendinous reflexes rotulian drt and left (esq) existing, but not very expressive. Feel fatigue and pain in the dorso-cervical region. Below are the tables with the assessment carried out using the Berg scale and the Tug .

Berg* Scale *(11-02-20)														
a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
b)	4	4	4	4	4	3	3	3	2	3	2	3	0	1

a) Berg scale item number

b) Berg scale score

Timed Up & Go (11-02-20)	
TUG (cone at 3 meters)	27 seconds 25 seconds 21 seconds

Assessment instruments

The Berg scale was used to assess functional balance. It has a maximum score of 56 points, with each item having an ordinal scale of 5 alternatives ranging from 0 to 4 points. The test is simple, easy to administer and safe for evaluating elderly patients. It only requires a stopwatch and a ruler as equipment and its execution takes around 15 minutes (Berg K. et all , 1992). This scale was subjected to a process of cultural and linguistic adaptation, as well as verification of content validity, simultaneous/concurrent validity (n=20, r=0.93 (0.42) and n=33, Kendall=0.574 to 0.530 (0.000)), longitudinal validity/sensitivity to change (n=20 and n=33) and inter-observer reliability (n=20, r=0.94 (0.42) and n=33, Kendall=0.88 to 0.82 (0.000)) (Santos et al., 2005).

The Tug was created to test balance (Podsiadlo D. et al, 1991). The protocol for the Tug was administered according to the description by Podsiadlo D. et al, 1991.

The patient's main problems and treatment objectives

Considering the results of the subjective and objective assessment, the patient's main problems are: pain in the dorso-cervical region, ataxic gait, decreased balance and fatigue. In this sense, the objective of the rehabilitation process was: to reduce pain in the dorso-cervical region, re-educate the gait pattern, increase balance and physical conditioning, thus preventing and reducing the risk of falls.

Rehabilitation process

The rehabilitation process is described in the table below:

Date	Treatments
11-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (15 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (30 minutes depending on the patient's tolerance, with rest breaks)
12-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (15 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (30 minutes depending on the patient's tolerance, with rest breaks)
13-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (15 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (30 minutes depending on the patient's tolerance, with rest breaks)
14-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (15 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (30 minutes depending on the patient's tolerance, with rest breaks)
17-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (20 minutes depending on the patient's tolerance, with rest breaks) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 6. Standing with your eyes closed, 7. Standing with your feet together, 8. Leaning forward with your arm stretched out, 10. Turn to look behind you, 12. Place your feet alternately on a step (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on cycle ergometer (60% HR) (10 minutes)

18-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (20 minutes depending on the patient's tolerance, with rest breaks) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 6. Standing with your eyes closed, 7. Standing with your feet together, 8. Leaning forward with your arm stretched out, 10. Turn to look behind you, 12. Place your feet alternately on a step (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on cycle ergometer (60% HR) (10 minutes)
19-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (20 minutes depending on the patient's tolerance, with rest breaks) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 6. Standing with your eyes closed, 7. Standing with your feet together, 8. Leaning forward with your arm stretched out, 10. Turn to look behind you, 12. Place your feet alternately on a step (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on cycle ergometer (65% HR) (10 minutes)
20-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (20 minutes depending on the patient's tolerance, with rest breaks) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 6. Standing with your eyes closed, 7. Standing with your feet together, 8. Leaning forward with your arm stretched out, 10. Turn to look behind you, 12. Place your feet alternately on a step (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on cycle ergometer (65% HR) (15 minutes)
21-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) facilitation to re-educate the gait pattern with plantar proprioceptive stimulation (sponge mat and feet only in socks) (20 minutes depending on the patient's tolerance, with rest breaks) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 6. Standing with your eyes closed, 7. Standing with your feet together, 8. Leaning forward with your arm stretched out, 10. Turn to look behind you, 12. Place your feet alternately on a step (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on cycle ergometer (65% HR) (15 minutes)
24-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 9. Pick up an object from the floor, 11. Turn 360 degrees, 13. Stand with one foot in front of the another, 14. Standing on one leg (20 minutes depending on the patient's tolerance, with rest breaks) "8" circuit with chairs (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on the treadmill (2.5 km/h 15 minutes)

26-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 9. Pick up an object from the floor, 11. Turn 360 degrees, 13. Stand with one foot in front of the another, 14. Standing on one leg (20 minutes depending on the patient's tolerance, with rest breaks) "8" circuit with chairs (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on the treadmill (2.6 km/h 15 minutes)
27-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 9. Pick up an object from the floor, 11. Turn 360 degrees, 13. Stand with one foot in front of the another, 14. Standing on one leg (20 minutes depending on the patient's tolerance, with rest breaks) "8" circuit with chairs , throwing a ball (front, left side and left) (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on the treadmill (2.7 km/h 15 minutes)
28-02-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) balance training (use of the Berg scale as an intervention with a sponge mat and feet in socks) – 9. Pick up an object from the floor, 11. Turn 360 degrees, 13. Stand with one foot in front of the another, 14. Standing on one leg (20 minutes depending on the patient's tolerance, with rest breaks) "8" circuit with chairs, throwing a ball (front, left side and left) (20 minutes depending on the patient's tolerance, with rest breaks) aerobic training on the treadmill (2.8 km/h 15 minutes)
02-03-20	dorsocervical parafango (15 minutes) dorso-cervical massage (10 minutes) "8" circuit with chairs, throwing a ball (front, left side and left) (20 minutes depending on the patient's tolerance, with rest breaks)

Results

On March 2, 2020, the user walked without a walking aid (cane). The muscle test on the main muscle groups of the MI results in a 5, except for the tt dorsal flexors drt , resulting in a 4+. Osteotendinous reflexes rotuliano drt and esq existing, but not very expressive. Below are the tables with the results of the final assessment made using the Berg and Tug scale .

Berg Scale (02-03-20)														
a)	1	2	3	4	5	6*	7*	8*	9**	10*	11**	12*	13**	14**
b)	4	4	4	4	4	4*	4*	4*	4**	4*	3*	4*	3***	4***

a) Berg scale item number: *that was used in the rehabilitation process from 02-17-20 to 02-21-20 and **that was used in the rehabilitation process from 02-24-20 to 03-02-20

b) Berg scale score: *which increased by 1 point, **which increased by 2 points and ***which increased by 3 points, since the first assessment

Timed Up & Go (02-03-20)	
TUG (cone at 3 meters)	12 seconds 11 seconds 10 seconds (minus 11 seconds, 47.6% improvement since the first evaluation)

Discussion

In the rehabilitation process of this patient, parafango and massage were used with the aim of reducing pain in the dorso-cervical region. It is suggested that the pain-relieving property of massage therapy is attributed to the reduction of substance P and increase in serotonin. There is evidence that massage therapy increases serotonin and decreases cortisol, providing relief from negative emotional symptoms such as depression and anger, thereby increasing positive mood (Field, 2010).

In facilitating gait pattern retraining with plantar proprioceptive stimulation (sponge mat and socked feet), neurorehabilitation research on locomotor intervention suggests that specific rehabilitation training leads to increased improvements in gait outcomes (Bayona N. et all , 2005) (Hubbard I. et all , 2009), since these results indicate that patients' postural sway is reduced and the gait movement pattern becomes more consistent during locomotion, suggesting improvements in gait stability (Seung-Jin Im et all , 2016).

Vestibular rehabilitation techniques have evolved in recent decades and there is reliable research on the effectiveness of vestibular exercises in peripheral vestibular dysfunction. Personalized treatment programs focus on decreasing symptoms of dizziness, oscillopsia , postural instability, and treating the patient's functional deficits . The aim of the exercises is to promote central compensation for vestibular dysfunction (Sulway S. et all , 2019).

The “figure 8” circuit disturbed by throwing a ball, from the front and side, to the patient makes sense because, when exposed to repeated disturbances, the neuromotor system is stimulated to develop the necessary neurophysiological changes and sensorimotor skills. to prevent falls (Grabiner M. et all , 2014). Perturbation-based balance training has been reported to be potentially effective for populations with balance disorders, promoting greater postural stability (Chien and Hsu , 2018; Handelzalts S. et all , 2019; Klamroth S. et all , 2019), reducing the incidence of falls (Gerards M. et all , 2017; Mansfield A. et all , 2017) and improving functional performance in individuals with neurological conditions (Steib S. et all , 2017).

Solid experimental evidence suggests that physical exercise can promote brain plasticity through activation of neurotrophin , synaptogenesis , angiogenesis and neurogenesis signaling pathways . Furthermore, the beneficial effects of aerobic exercise may be mediated by reducing the oxidative stress of neuroinflammation and improving intracellular calcium homeostasis (Ferrazzoli D. et al. all , 2020), and in a review of 42 randomized and controlled studies, it is demonstrated that exercise is a safe and effective intervention to reduce fatigue and improve mobility in adult cancer survivors (Dennett A. et all , 2016).

This case study has some limitations mainly in the evaluation, as more scales should be used, namely the Scale for Assessment and Classification of Ataxia (SARA) and the Fatigue Severity Scale (FSS). And in the intervention process, more coordination exercises should be carried out.

Conclusion

After analyzing this case study, it is possible to conclude that physiotherapy, specifically: therapeutic massage, re-education of the gait pattern, namely facilitation of half-step with handling on the foot, ankle and knee, balance training inspired by the Berg Scale, functional training with the promotion of dynamic instability and aerobic exercise result in good strategies to reduce postural instability, maximize functional capacity and minimize sequelae of surgical removal of tumors in the

fourth ventricle.

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