



Efficacy of early rehabilitation in a patient with spinal cord ischemia and hypoxic-ischemic encephalopathy: A case report

Omurilik iskemisi ve hipoksik-iskemik ensefalopatili bir hastada erken rehabilitasyonun etkinliđi: Olgu sunumu

Rukiye Çiftçi¹, Fatma Kizilay², Davut Özbađ³, Yüksel Ersoy¹

¹Department of Physical Medicine and Rehabilitation, Faculty of Medicine, İnönü University, Malatya, Turkey

²Department of Physical Therapy and Rehabilitation, Faculty Of Health Sciences, İnönü University, Malatya, Turkey

³Department of Anatomy, Faculty of Medicine, İnönü University, Malatya, Turkey

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Abstract

A 26-year-old male patient was admitted to Physical Medicine and Rehabilitation (PMR) inpatient clinic with a diagnosis of tetraplegia due to hypoxic-ischemic encephalopathy and spinal cord ischemia. The coexistence of both conditions is a rare condition. This case report aims to examine how early treatment in terms of rehabilitation would benefit the patient's severe condition. Motor and functional evaluations were performed before and after the 8-weeks rehabilitation program. Biodex isokinetic strength and balance tests were used to evaluate lower extremity muscle strength and balance status. Also, the 6-minute walking test was performed, and the pinch and handgrip strength were measured. Disability of the Arm, Shoulder, and Hands Index (DASH) was used to evaluate the upper extremity functions, and the Functional Independent Measures (FIM) Questionnaire was used to determine the independence level. As a result of an early rehabilitation program, motor and functional status of the patient improved significantly.

Keywords: Spinal cort ischemia; balance; isoknetic

Öz

26 yaşında erkek hasta hipoksik-iskemik ensefalopati ve omurilik iskemisine bađlı tetrapleji tanısı ile Fizik Tedavi ve Rehabilitasyon (PMR) kliniđine bařvurdu. Her iki durumun bir arada bulunması nadir bir durumdur. Bu çalıřma rehabilitasyon uygulana hastada erken tedavinin hastanın ađır durumuna nasıl yarar sađlayacađını incelemeyi amaçlamaktadır. Motor ve fonksiyonel deđerlendirmeler 8 haftalık rehabilitasyon programından önce ve sonra yapıldı. Alt ekstremite kas kuvveti ve denge durumunu deđerlendirmek için biodex izokinetik kuvvet ve denge testleri kullanıldı. Ayrıca, 6 dakikalık yürüme testi yapılmıř ve kavrama gücü ölçülmüřtür. Üst ekstremite fonksiyonlarını deđerlendirmek için Kol, Omuz ve Ellerde Engellilik İndeksi (DASH), bađımsızlık seviyesini belirlemek için Fonksiyonel Bađımsız Önlemler (FIM) Anketi kullanılmıřtır. Erken rehabilitasyon programının bir sonucu olarak, hastanın motor ve fonksiyonel durumu önemli ölçüde iyileřti.

Anahtar Kelimeler: Omurilik iskemisi; denge; izokinetik

INTRODUCTION

Spinal cord infarction is the rarest stroke type among all stroke types with a rate of 1%. While it is reported that spinal cord ischemia may develop more frequently after aortic surgery, the etiology of non-surgical ischemia is not well known. Partial recovery is generally observed during hospitalization, and unilateral infarcts have been reported to have a better prognosis (1).

The brain is highly susceptible to a lack of blood circulation due to its high metabolic requirements. A short-term

restriction may cause ischemia. It has been shown that brain glucose, glycogen, adenosine triphosphate, and phosphocreatine concentrations decrease immediately after the onset of ischemia. Damage can also be delayed. Cardiac arrest may result in severe hypoxia and ischemia due to circulatory arrest. In global ischemia following cardiac arrest, tissue damage occurs in 95% of the brain after 15 minutes (2).

Early initiation of rehabilitation in patients with brain ischemia is a critical point for the rapid recovery of the functions. When brain injury and spinal cord ischemia

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Sorumlu Yazar /Corresponding Author: Rukiye Çiftçi, Department of Physical Medicine and Rehabilitation, Faculty of Medicine, İnönü University, Malatya, Turkey, E-mail: rukiyekelesciftci@hotmail.com

Phone: +090 532 069 15 96

occur simultaneously, the literature for the effectiveness of early rehabilitation is extremely limited. This study aims to determine the prognostic effects of global motor and functional deficits caused by the coexistence of these two neurological conditions on the rehabilitation process.

CASE REPORT

A 26-year-old male patient was admitted to the country state hospital with pain and weakness in both upper extremities, which he had never felt like this before. Then it was reported that medical treatment applied to the patient and discharged from the hospital. It was determined that the patient was taken to the same emergency center with shortness of breath; at the same time, the patient arrested and returned after two minutes of cardio-pulmonary resuscitation. Following this, the patient was accepted by the reanimation intensive care unit of a university hospital where thorax computed tomography showed pulmonary artery embolism and left atrium was reported as large with fibrosis in the lung apex. In spinal angiography, C2-C6 and T2-T4 gray and white matters were considered as spinal cord ischemia due to anterior involvement. After one month of the intensive care unit treatment, the patient was admitted to the Physical Medicine and Rehabilitation (PMR) inpatient clinic with the diagnosis of tetraplegia due to hypoxic-ischemic encephalopathy and spinal cord ischemia. The patient was cooperative, oriented and the general condition was good. Although the patient has stool continence, it has been reported that a urinary catheter was present but may feel partial bladder fullness. Sensory examination revealed mild touch and needle sensation.

Before all, the process of informed consent was informed about the study, and the consent form has been signed. Motor and functional evaluations were performed before and after the 8-week rehabilitation program. The demographic data of the patient was obtained. Some tests were performed before and after the treatment to evaluate the benefit of the treatment. The isokinetic strength tests and the balance tests were used to evaluate lower extremity muscle strength and balance status. The 6-minute walking test was performed. The pinch strength was measured with pinch meter. Disability of the Arm, Shoulder, and Hands Index (DASH) was used to evaluate upper extremity functions, and the Functional Independent Measures (FIM) questionnaire was used to determine the independence level.

The patient was evaluated according to the American Spinal Injury Association scale for spinal cord injury (ASIA) in the level of ASIA-C (motor incomplete). Motor functions are preserved below the neurological level 1, and more than half of the muscles below this level have strength lower than 3/5 (0, 1 or 2) (3).

The disability level of the patient was assessed by using FIM. FIM scoring is an 18-item scale with six sub-divisions assessing four motors and two cognitive areas, and each question was asked to the patient and scored between 1 and 7 (1: Total assistance, 7: Complete independence). Motor and cognitive area scores were recorded separately

(4). Daily life activities of the patient were evaluated with Barthel's Daily Life Activities Index (5).

Handgrip strength (HGS) and pinch grip were measured at a standardized test position recommended by the American Society of Hand Therapists (ASHT) (6). Handgrip strength measured by using Jamar hand dynamometer (Lafayette Instrument Company, USA) and pinch grip strength measured by using Jamar pinch meter (Lafayette Instrument Company, USA).

Isokinetic strength tests of the knee and ankle muscles were conducted by using Biodex System-3 (BS-3, Biodex Medical Systems, Shirley, 2000, New York). Before the isokinetic tests, a 10-minute long warm-up was performed with Fitron (Lumex Corp., Ronkonkoma, NY) lower extremity bike. For strength measurement, the subject was made to sit and then fixed by using the leg, femoral, pelvic, and upper body diagonal stabilization straps according to Standard Biodex procedure. Before the measurement, the patient watched the demo video of the test, and the exercise phase was performed with the three repetitions. The test was performed after a 15-minute rest following the exercise phase. Knee extension (0°) and flexion (100°) and ankle dorsiflexion (15°) and plantarflexion (15°) muscles strengths were assessed by using concentric/concentric mode at 90°/sec angular speed. The test procedure was conducted according to the manufacturer's guideline (7). The parameters of the peak torque (Newton meter-Nm), the average power (Watt), the total work (Joule), and H/Q peak torque ratios were analyzed from the automatic printout taken from the device (Figure 1).



Figure 1. Isokinetic strength tests of the knee and ankle muscles

Biodex Balance System (BBS) (Biodex Medical Systems, Shirley, 2000, New York) was used to measure the balance parameters in the study. Antero-posterior (AP), mediolateral (ML), and overall (OA) balance indexes and total time (TT) were tested with eyes open by an expert. The measurements were made on the balance platform, with bare feet, feet's opened at the width of shoulder, knees in 15° flexion, and hands were combined on the chest. The test started at level 8 and ended at level 3 (8) (Figure2).



Figure 2. Biodex Balance System (BBS) was used to measure the balance parameters in the study

A 6-minute walk test was performed at a physiotherapy rehabilitation hall on a 20 m long marked flat surface by using a chronometer. The test was performed with the shoes of the patient used in his daily life. The patient was asked to determine his own walking space and walk the longest distance he could walk in 6 minutes. He was told that he could slow down or give a break to the test if he needs. The patient was reminded of the remaining time at the fourth and fifth minutes of the test. At the end of 6 minutes, walking distance covered was calculated by using the bands fixed to the test track every 2.5 meters. The result was recorded in meter (m) (9).

Upper, lower, and trunk range of motion movements (ROM) and progressive neuromuscular stabilization (PNF) exercises (hold-relax, muscle-relax) were performed as a rehabilitation program. Electrostimulation (muscle

strengthening 20 min to both shoulders and waist) was performed to increase muscle strength. The balance was attempted while standing and sitting. Walking in parallel bars and fine motor exercises were also studied. Biodex Balance System was used six weeks after starting the treatment for balance study. Biodex Isokinetic Medical Systems was used for exercises after six weeks to increase muscle strength (Table 1).

Table 1. Motor Performance (strength and balance) assessments and functional evaluations (walking, DASH, and FIM)

Parameters	Pre-Treatment	Post-Treatment
RL Ext peak torque (Nm)	35.3	65.6
RL Flex peak Torque (Nm)	17.1	36.2
RL H/Q Ratio %	48.4	55.1
LL Ext peak torque (Nm)	29.6	47.8
LL Flex peak Torque (Nm)	11.2	20.4
LL H/Q Ratio %	37.8	42.8
RA DF peak torque (Nm)	10.8	24.0
RA PF peak torque (Nm)	20.3	39.6
LA DF peak torque (Nm)	8.4	17.2
LA PF peak torque (Nm)	17.2	29.3
RA D/P ratio %	53.2	60.7
LA D/P ratio %	48.8	58.6
R Hand Grip (kg)	9.5	22.0
L Hand Grip (kg)	5.5	19.5
R pinch (kg)	2.0	7.0
L pinch (kg)	1.5	4.5
AP Balance index	Patient failed to test	2.7
ML Balance index	Patient failed to test	2.2
OA Balance index	Patient failed to test	3.3
TT (sec)	Patient failed to test	67
DASH	80	52.5
FIM motor area score	11	47
FIM cognitive area score	9	21
6 min walk (m)	Patient failed to test	420
Barthel's Index score	15	95

RL: sağ bacak, LL sol bacak, RA sağ ayak, LA sol ayak.

DISCUSSION

Spinal cord MRI may be normal or may show diffuse abnormalities. In this case, magnetic resonance angiography did not identify the anterior spinal artery (10). This patient was young and had no cardiac output for 2 minutes. There was no risk factor, else. Although neuronal necrosis has been identified in neonates and premature infants who had hypotensive attacks, it is not age-related (10-12). In this case, the effect of age on the

outcome can only be speculative.

Heinz et al examined the effect of early rehabilitation in 93 patients with hypoxic brain injury and stated that in 23 patients, early rehabilitation was not effective in 70 patients. This study does not support us (12).

A temporary ischemic attack may occur due to prolonged hypotension as a result of cardiac arrest (13). Although the cardiovascular outcome was excellent in this patient, rare and significant neurological morbidity has occurred. The researchers reported that patients with tetraplegia after spinal ischemia might have a loss of balance and loss of strength in the lower limb muscles (14). These results supports our study.

DPhil et al. As a result of rehabilitation applied to patients with spinal court injuries, they used FIM to measure independence and obtained good results. They reported that FIM is an appropriate method to measure independence as a result of rehabilitation (15). Our case supports this result.

Tysseling et al. (16) reported that FIM increased significantly, and DASH decreased significantly after physiotherapy treatment in patients with tetraparesis following spinal cord ischemia. Our study supports this result. Ditunno et al. (17) performed a 6-minute walk test before and after rehabilitation in 37 patients with spinal artery ischemia and obtained significant results. In our study, our patient could not do a 6-minute walk test before rehabilitation and then took 420 steps.

According to the results obtained from objective tests, we can say that the PNF exercises, such as muscle stretching and strengthening exercises rehabilitation program in spinal cord ischemia makes a significant difference in the improvement of motor function such as strength, balance, and walking. Conflicting results and lack of consensus in the literature indicate that further studies are needed. However, more isolated applications are needed to demonstrate the effectiveness of rehabilitation in the treatment of spinal ischemia.

In our study, the effectiveness of 8-week rehabilitation was investigated, but the long-term effectiveness of the treatment was not observed. Studies examining longer term rehabilitation efficiency are needed.

Informed Consent: *The patients included in the study signed the informed consent form.*

Conflict of Interest: *The authors declare that they have no competing interest*

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