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Case Study

Effect of Motor Imagery Technique for Rehabilitation in Patient with Spinal Cord Injury- A Case Study

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ABSTRACT

Aim: Motor imagery has been studied in various neurological conditions such as stroke and spinal cord injury. The purpose of this case study is to evaluate the effect of motor imagery technique in patient with chronic spinal cord injury.
Case Description: A 19 year old male patient with spinal cord injury received motor imagery technique in addition to conventional physiotherapy treatment for rehabilitation for period of 4 weeks. Intervention was focused on gait and on impairments of the lower limbs. Pre intervention and post intervention MMT, ROM, Berg balance scale, Total spinal cord independence measure and ASIA scale was taken.
Results: At end of 4 weeks there was improvement in muscle power of hip, knee flexors and ankle musculature; ankle range of motion; score of total spinal cord independence measure and ASIA scale.
Conclusion: From the present study we can conclude that motor imagery technique can be given in addition to conventional physiotherapy for rehabilitation in patients with spinal cord injury.

Key Words: Spinal cord injury, Motor imagery technique, Rehabilitation.

INTRODUCTION

The spinal cord is the long cylindrical lowest part of central nervous system. It occupies upper two-thirds of vertebral canal. It gives rise to 31 pairs of spinal nerves. Spinal cord extends from upper border of atlas vertebra to the lower border of first lumbar or second lumbar in an adult. Superiorly it continues with the medulla oblongata, inferiorly it terminates as conus medullaris. It is surrounded by three meninges. Outer most Dura mater, middle arachnoids mater and innermost is the piamater. Spinal cord presents cervical enlargement for supply of upper limb muscles. This extends from C4 to T2 spinal segments with maximum diameter at the level of C6 segment. Another enlargement is the lumbar enlargement for supply of muscles of lower limb. [1]

Spinal cord injuries typically divided into two broad functional categories: quadriplegia and paraplegia. Spinal cord injury is a low incidence, high cost disability requiring tremendous change in an individual's lifestyle. A fall from height is the commonest mode of sustaining a spinal injury in developing countries. [2] The treatment of spinal cord injuries can be done in the three phases. Emergency care, definitive care and rehabilitation. Emergency care will be done at the site of the accident and in the emergency department. Definitive care depends upon the stability of spine. And rehabilitation

protocol will make the individual independent. [3]

Motor imagery technique is imagining of actions without their execution, can be defined as an active process during which the representation of a specific action is internally reproduced within working memory without any overt output. [4] Two types of imagery perspectives are there: external (a perspective that involves primarily a visual representation of motor task, i.e., third person); and internal (involves kinesthetic and visual representation from inside, i.e., first person of the simulated movements). During the rehabilitation phase emphasis is given more on functional independence of the person. Mental practice might be used alongside physical rehabilitation in patients with neurological disorders and will probably be most effective in the early recovery stage during which the reorganization of brain patterns is most prominent. [5] There is less literature [6,7] available showing the effect of motor imagery technique on chronic spinal cord injury patients so need of this study is to determine the effect of motor imagery technique in patient with chronic spinal cord injury.

CASE DESCRIPTION

A 19 year old male patient presented to physiotherapy department of G.G Hospital, Jamnagar with complaint of inability to do sit to stand independently and having difficulty in walking with inability to lift right foot since 2 years. There was a history of fall that led to spinal cord injury 2 years ago. Investigations show that there is traumatic fracture wedging of L2 vertebrae with posterior retropulsion causing severe lumbar canal stenosis and severe compression of nerve root of cauda equina. There is also right side partial ligamentum flavum tear noted at L2-L3 level. The patient underwent surgery after 1 day of injury. Patient was operated for L2 fracture under general anesthesia pedicle screw fixation and decompression was done. He was kept in hospital for 13 days. After surgery he had not taken any Physiotherapy treatment and was totally dependent on his family members for his all activities of daily living.

ASSESSMENT AND MANAGEMENT

ON OBSERVATION

Body built: Mesomorphic

Mode of ambulation: Walking with Walker

Attitude of limb: Feet remain in inversion bilaterally

ON EXAMINATION

Reflexes: Bilaterally knee and ankle jerk can't be elicited

Sensations: Hypoesthesia in bilateral lower limbs from L3 level

Joint proprioception: It is affected bilaterally in ankle joint.

Tightness: Bilateral rectus femoris and calf muscles are tight.

Gait: Patient walks with walker and toe raising splint.

Manual muscle testing, range of motion, berg balance scale and ASIA scale was taken on the 1st day and at the end of 4 weeks. It is as given below in the following table no. 1 to 4.

Muscle testing was performed and scoring was based on Manual Muscle Testing

Table 1: Muscle Strength

	Pre intervention		**Post intervention**	
Muscles	**Right**	**Left**	**Right**	**left**
Upper limb	5/5	5/5	5/5	5/5
Lower limb				
Hip flexors	4/5	4/5	5/5	5/5
Hip extensors	5/5	5/5	5/5	5/5
Hip abductors	5/5	5/5	5/5	5/5
Hip adductors	4/5	4/5	4/5	4/5
Hip internal rotators	5/5	5/5	5/5	5/5
Hip external rotators	5/5	5/5	5/5	5/5
Knee flexors	4/5	4/5	5/5	5/5
Knee extensors	5/5	5/5	5/5	5/5
Ankle dorsiflexors	0/5	2/5	1/5	4/5
Ankle plantarflexors	1/5	1/5	1/5	2/5
Ankle invertors	0/5	3/5	1/5	3/5
Ankle evertors	0/5	1/5	1/5	1/5

ROM was measured with universal goniometer.

ROM of shoulder, elbow and wrist joint is normal bilaterally.

Table 2: Range of Motion:

	Pre intervention		Post intervention	
ROM	**Right**	**Left**	**Right**	**Left**
Hip flexion	0-125 º	0-125 º	0-125 º	0-125 º
Hip extension	0-25 º	0-25 º	0-30 º	0-30 º
Hip abduction	0-45 º	0-45 º	0-45 º	0-45 º
Hip adduction	0-30 º	0-30 º	0-30 º	0-30 º
Hip internal rotation	0-40 º	0-40 º	0-40 º	0-40 º
Hip external rotation	0-45 º	0-45 º	0-45 º	0-45 º
Knee flexion	0-125 º	0-125 º	0-125 º	0-125 º
Knee extension	125-0 º	125-0 º	125-0 º	125-0 º
Ankle dorsiflexion	0-5 º	0-10 º	0-8 º	0-15 º
Ankle plantarflexion	0-5 º	0-45 º	0-5 º	0-50 º
Ankle inversion	0-5 º	0-30 º	0-10 º	0-30 º
Ankle eversion	0-5 º	0-7 º	0-8 º	0-10 º

Table 3: Berg balance scale score

Berg balance scale score	**Pre intervention**	**Post intervention**
	17/56	17/56

Table 4: Total spinal cord independence measure score

Activities	**Pre intervention Score**	**Post intervention Score**
Feeding	3/3	3/3
Bathing	4/6	5/6
Dressing	7/8	8/8
Grooming	3/3	3/3
Respiration	10/10	10/10
Sphinter Management-Bladder	15/15	15/15
Sphinter Management-Bowel	10/10	10/10
Use of toilet	2/5	4/5
Mobility in bed and action to prevent pressure sores	6/6	6/6
Transfers: bed to wheelchair	2/2	2/2
Transfers: wheelchair-toilet-tub	2/2	2/2
Mobility indoors	4/8	6/8
Mobility for moderate distance(10-100 meters)	4/8	6/8
Mobility outdoors(>100 meters)	3/8	3/8
Stair management	1/3	2/3
Transfers: wheelchair-car	1/2	1/2
Transfers: ground to wheelchair	0/1	0/1
Total spinal cord independence measure score	**77/100**	**86/100**

Table 5: ASIA scale

		Pre intervention			Post intervention		
		Right	**Left**	**Total**	**Right**	**Left**	**Total**
Motor sub scores	Upper extremity	25/25	25/25	**50/50**	25/25	25/25	**50/50**
	Lower extremity	10/25	12/25	**22/50**	11/25	18/25	**29/50**
Sensory sub scores	Light touch	47/56	47/56	**94/112**	48/56	48/56	**96/112**
	Pin prick	47/56	47/56	**94/112**	52/56	51/56	**103/112**

PROTOCOL [8, 9]

Patient was given conventional physiotherapy treatment along with motor imagery technique. The dosage for motor imagery technique was 20 minutes, 6 days a week for 4 weeks.

Strengthening exercises: Straight leg raise in all the 3 planes, hip internal and external rotators and knee extensors strengthening in high sitting, knee flexors strengthening in standing with 1 kilogram sand bag. Dorsiflexors and plantarflexors strengthening with theraband.

Stretching exercises: Bilateral calf and rectus femoris stretching.

For sensory stimulation: Brushing and vibration on affected dermatomes.

Balance training: Standing with narrow base of support**,** one leg standing, weight shifting exercise with reach outs in parallel bars.

Functional training: Sit to stand from low stool, step up and step down, partial squats with wall support, mat activities like kneel standing and half kneeling.

Gait training: Walking with toe raising splint in parallel bar with mirror biofeedback.

Proprioceptive training: Walking with 1 kilogram sand bag and toe raising splint in parallel bar with mirror biofeedback.

Electrical stimulation: Intermittent galvanic current for right dorsiflexors and evertors and bilateral plantarflexors.

Motor imagery technique: In this study internal imagery perspective is used (which involves kinesthetic and visual representation from inside, i.e., first person of the simulated movements). Relaxation was given to the patient prior to motor imagery technique. Then motor imagery technique was given for foot movements, sensory stimulation gait training. The instructions given to him were – to do deep breathing and relax all the joints of the body, he was asked to imagine that he is walking the way he used to walk prior to the injury. Then he was asked to imagine first on grass and then on an uneven surface. Then to do one leg standing, to go uphill and downhill and to do step up and step down.

RESULTS

After intervention of 4 weeks patient was able to walk with support of cane along with toe raising splint in outdoors and with minor support indoors, which was with using walker along with toe raising splint earlier and he started doing his self -care activities such as toileting, dressing by himself.

Pre – intervention, muscle strength of hip, knee flexors and ankle musculature was weak; range of motion of ankle joint was reduced; score of total spinal cord independence measure and ASIA scale was low. At the end of the intervention (week 4), there was improvement in muscle power of hip, knee flexors and ankle musculature; ankle range of motion; score of total spinal cord independence measure and ASIA scale as shown in table no.1-5.

DISCUSSION

The present study has looked at the effect of an exercise program consisting of conventional physiotherapy treatment along with motor imagery technique in a patient with paraparesis due to spinal cord injury. Mental practice allows patients to visualize themselves performing physical movements in real-life situations, to practice with simplicity. Mental imagery technique needs no special instrument and are easily trained and learned. Findings of this study have demonstrated improvements in terms of muscle strength, range of motion, spinal cord independence measure, ASIA scale and gait. This is because motor imagery technique demands the implementation of a cognitive task and most likely includes the planning and mental rehearsal of the entire activity or task to be performed. The results obtained from this case study are similar to the study done by S. Hotz-Boendermaker et al. in 2008 [7] which concluded that motor imagery may be useful adjuncts to traditional rehabilitation strategies for improving motor functions after spinal cord injury.

Our findings are consistent with the study of Dickstein et al. (2004); [10] who found that MI may be useful for the enhancement of walking ability in patients following stroke. Similar results were demonstrated by Steven Cramer et al. (2007) [6] who concluded that motor imagery might be of value as one component of a restorative intervention in patient with spinal cord injury. This suggests that motor imagery training is able to modify some brain functions related to attempted movement, despite the absence of overt movements.

Aikat R, Dua V (2016) [11] in a systematic review found that the therapeutic benefits of motor imagery were mixed, with more weightage going towards motor recovery as compared to pain and other sensory areas. These findings are partially consistent with the results of our present study that improvement is seen in motor functions as well as sensory areas. Thus, it is found that

better results are obtained by combining mental and physical practice of a task.

CONCLUSION

From the present study we can conclude that for improvement in muscle power, sensory affection specifically for pin prick, reduction in assistance for gait , motor imagery technique can be given in addition to conventional physiotherapy for rehabilitation in patients with spinal cord injury.

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