



The Effect of Neuromuscular Electrical Stimulation (NMES) and Proprioceptive Neuromuscular Facilitation (PNF) in Increasing Extremity Muscle Strength of Hemiparesis Dextra Patient: A Case Study

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Abstract

Introduction: Stroke is the second leading cause of death and third disability in the world. Data from the World Stroke Organization shows that every year there are 13.7 million new cases of stroke and about 6.7 million deaths that occur due to stroke. Stroke causes paralysis that worsens, and creates limitations in contractile or non-contractile tissue, and reduces range of motion in joints.

Case Presentation: A case study on a 68-year-old man who had his first stroke in August 2020 and found a decrease in muscle strength, pain at the end of movements of shoulder, elbow and knee flexion along with decreased functional ability in the right extremity.

Management and outcome: The patient received a therapeutic approach with NMES and PNF for 4 times for 2 weeks. This programs could improve muscle strength and decreased the level of pain among men with Hemiparesis Dextra

Discussion: The study states that NMES appears to be an effective physical rehabilitation treatment to initiate skeletal muscle anabolic processes that promote muscle growth and strengthening in hemiparetic and healthy older skeletal muscle. In addition, PNF technique to the non-affected side as well as the affected side, where both had abnormally increased muscle tone and stiffness due to a post-stroke upper motor neuron lesion, had positive effects. Furthermore, the PNF combined pattern is an effective treatment method for increasing the muscle activity.

Conclusion: After physiotherapy treatment 4 times for 2 weeks there was an increase in muscle strength and a decrease in pain at the end of passive flexion of the shoulder, elbow and knee.

Keyword: Stroke, Hemiparase, NMES, PNF



Introduction:

Stroke represents the fourth cause of death worldwide and survivors present a combination of muscle weakness or imbalance, decreased postural control, muscle spasticity, poor voluntary control, and body misalignments [1]. 13.7 million people worldwide will have their first stroke this year and five and a half million will die as a result. Current trends suggest that the number of annual deaths will climb to 6.7 million annually without appropriate action [2]. Stroke was classified into two types such as haemorrhagic and ischemic. The haemorrhagic strokes caused by rupture of blood vessel which caused bleeding into the brain parenchyma and damage to brain tissue, while ischemic strokes is occurred since blood supply blockage into artery leads to brain ischemia and infarction [3]. The consequences of a stroke depend on its severity, brain location, and type. Patients prognosis is highly dependent on some baseline characteristics such as age, gender, or stroke severity [1].

Hemorrhagic stroke caused severe and damage to the brain tissue leads to individual paralysed or weak, difficulty in speaking, swallowing, think properly or doing any daily activities [3]. The long-term non-use of muscles induces often adaptive muscle contraction and causes atrophy of the motor cortex that is responsible for each of the physical body parts, resulting in worsening paralysis and creates limitations in contractile or non-contractile tissues, as well as reducing the range of motion. It also causes changes in the joints due to long-term limitations in mobility, making functional physical activity difficult. [4] Although patients' social situation, life experience and personality play a part in their recovery, the nature of the resulting impairments play a key role. These impairments can lead to wide-ranging activity limitations for which individual patients require personalised rehabilitation.[5].

The poststroke motor recovery is complex due to genetic, pathophysiologic, sociodemographic, and clinical factors. NMES is one of the therapeutic interventions that has been developed to try to induce the motor recovery. In general, NMES often stimulates specific muscles, but in the case of muscle strengthening in stroke rehabilitation, multiple muscles, including those on the non-paralyzed side, are stimulated to enhance muscle strength [6]. PNF is a technique that improves movement function by stimulating muscles, tendons, and joints, and increases muscle power, flexibility, and balance. It has been used as an intervention in musculoskeletal disorders of muscles, bones, and joints and in central nervous system disorders resulting from stroke. The basic principles used in PNF resulted in more muscle power when applying various patterns at the same time, and the use of combination patterns improved the proprioception, power, and stability [7].

Case Presentation

Mr. M is 68 years old with complaints of stiffness and weakness in the right hand and foot. The patient had no previous history of other diseases. The patient had his first stroke in August 2020. 10 days before the attack, the patient complained of difficulty sleeping, felt dizzy and when he checked his blood pressure the result was 150/80 mm/Hg. On the day of the stroke, the patient complained of dizziness and when he was brought to the nearest health center with a blood pressure of 200/100 mm/Hg, he was advised to suggest therapy but refused. The patient went home and 10 minutes at home, suddenly the legs and arms were immobile and weak. Then the patient was immediately taken to hospital and treated for 5 days.

On physical examination, the patient was found to walk without using a tool with a hemiplegic gait, the posture tends to tilt to the right side, the fingers of the right hand, wrist joint and elbow joint are semi-flexed and slightly internally rotated and the ankle is slightly plantar flexed. The patient also complained of pain at the end of passive shoulder flexion, VAS scale 5.5/10, pain in



elbow flexion 5.2/10 and knee flexion 4.3/10. Examination of muscle strength using the manual muscle test (MMT) showed that there was a decrease in muscle strength on the side affected by the stroke (Table 1).

Table 1. The result of MMT assessment

		Muscles	MMT Right	MMT Left
Muscle Testing (Upper Limb)	Shoulder	Flexors	2+	5
		Extensors	2+	5
		Adductors	2+	5
		Abductors	2+	5
		External rotators	2+	5
		Internal rotators	2+	5
	Elbow	Flexors	3	5
		Extensors	3	5
	Forearm	Supinators	3+	5
		Pronators	3+	5
	Wrist	Flexors	2-	5
		Extensors	2-	5
	Hip	Flexors	3-	5
		Extensors	3-	5
		Adductors	3-	5
		Abductors	3-	5
		External rotators	3-	5
		Internal rotators	3-	5
	Knee	Flexors	4-	5
		Extensors	4-	5
	Ankle	Dorsiflexor	2-	5
		Plantar flexor	2-	5
	Foot	Evertor	2-	5
		Iverter	2-	5

The patient did not experience any sensory disturbances, sensory examination such as sharp, blunt, smooth, and rough did not show any difference between the affected side (right) and the healthy side (left). The patient's functional ability was measured by the Barthel Index and showed a score of 85/100 which interpreted the dependence as mild. The patient is able to perform functional activities independently such as bathing, dressing, grooming, bladder, transfer and mobility. But for feed, dress, and stairs still need help.

Management and Outcome

The physiotherapy intervention given aims to increase muscle strength and improve functional ability. Patients underwent treatment 2 times a week for 2 weeks. The first intervention given was NMES for 15 minutes in the upper and lower extremities with a frequency of 150 Hz and a pulse of 15s and the intensity was adjusted to the patient's ability. Furthermore, PNF intervention was given



with rhythmical initiation, hold relax and contract relax on the movement pattern of each limb for 8-12 repetitions/3 sets. After 2 weeks, muscle strength, pain, and functional ability were re-measured. In addition, patients are also advised to do strengthening exercises to do at home in the form of hand, arm, bridging and leg raise exercises.

The results (Table 2) showed a slight increase in muscle strength and a decrease in pain. there was a pain examination, there was a decrease in the degree of pain at the end of the shoulder, elbow and knee flexion movements. Shoulder muscle strength also increased, although not too significant and no improvement in functional activity outcomes.

Table 2. The Result of Therapy

Measurement		Pre	Post
VAS	Shoulder Flexors	5.5/10	3.4/10
	Elbow Flexors	5.2/10	3.1/10
	Knee Flexors	4.3/10	2.7/10
MMT	Shoulder		
	Flexors	2+	3-
	Extensors	2+	3-
	Adductors	2+	3-
	Abductors	2+	2+
	External rotators	2+	3-
	Internal rotators		
	Elbow	3	3+
	Flexors	3	3+
Barthel Index	Extensors		
	Feeding	5	5
	Bathing	5	5
	Grooming	5	5
	Bowel	10	10
	Bladder	10	10
	Toiletting	10	10
	Transfer	15	15
	Mobilitas	15	15
	Stairs	5	5

Discussion

Every year, stroke survivors, related deaths, and disability-adjusted life-years are increasing, although the mortality rates for stroke have decreased in the last two decades [8]. Individuals suffering from stroke commonly experience hemiparesis, weakness on one side of the body, which often results in significantly compromised muscle function and decreased mobility; these effects of stroke can lead to a vicious cycle of continued muscle atrophy, strength loss, and impaired ability to participate in activities of daily living [9]. This is consistent with what is found in this case study report, where there is weakness in the upper and lower extremity muscles on the right side



due to a stroke that causes a decrease in muscle strength, pain at the end of the movement, functional and postural disorders.

In this case, the patient is a 68-year-old man who had his first stroke in August 2020. The patient has no previous medical history. The patient is a daily laborer who has not been able to return to his usual activities since the stroke until now. Complaints experienced by patients in the form of stiffness and weakness in the limbs on the right side. On physical examination, pain was found at the end of shoulder, elbow and knee flexion movements. In this pain assessment we used the VAS measuring instrument. VAS has been used for the subjective measurement of mood, pain, and health status after stroke [10]. However, in a study found that do not support the use of visual analogue scales as outcome measures for people with aphasia [11].

To check muscle strength use MMT. MMT is a widespread diagnostic tool all over the world. There is a broad variety of applications, e.g., in neurology, intensive care, physical therapy, osteopathy, sports medicine, and others. MMT is applied under many different intentions [12]. Furthermore The Barthel Index (BI), originally described in 1955 by Dr Florence Mahoney and Dorothea Barthel, is a 10-item measure of activities of daily living. In stroke medicine, BI is used in clinical practice to assess baseline abilities, to quantify functional change after rehabilitation, and to inform discharge planning [13].

Physiotherapy treatment in this case study was carried out for the purpose of increasing the strength of the weak right side muscle, reducing pain at the end of the movement and improving the patient's functional ability and avoiding muscle atrophy and contractures due to decreased activity after stroke. This is in accordance with previous research which stated that NMES appears to be an effective physical rehabilitation treatment to initiate skeletal muscle anabolic processes that promote muscle growth and strengthening in hemiparetic and healthy older skeletal muscle [9]. NMES works by inducing muscle contraction to obtain sufficient muscle strengthening effect, the stimulus intensity is set to the limit that patients can endure. This is based on reports that somatosensory input enhances corticomotoneuronal excitability to the stimulated body parts [6].

this study found that the application of the PNF technique can increase muscle strength in stroke patients. This is in accordance with the findings of previous studies, where they stated that the PNF technique to the non-affected side as well as the affected side, where both had abnormally increased muscle tone and stiffness due to a post-stroke upper motor neuron lesion, had positive effects. Furthermore, the PNF combined pattern is an effective treatment method for increasing the muscle activity [7] Apart from the treatment given, it is important to provide education in the form of strengthening exercises to patients to increase muscle strength and maintain muscle flexibility while at home.

Conclusion

After physiotherapy treatment 4 times for 2 weeks there was an increase in muscle strength and a decrease in pain at the end of passive flexion of the shoulder, elbow and knee.

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Conflict of interest:

None



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