CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

Bachelor thesis

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Case study of a patient with hemiparesis on the left side of the bod

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Dedication

This thesis is dedicated to Mozafari Niapour family, my great family and those who helped me to achieve my goals.

Table of Contents

Abstract

Physiotherapeutic case study of a patient with hemiparesis on the left side of the body as bachelor thesis is provided for you to show the full kinesiological assessment, special therapy approaches and therapy effect during 9 sessions. The further goal of this thesis is to explain the clinical picture, physiological points of view.

During my clinical practice, we used the main structure for the Kinesiological assessment according to the Prague School approaches. Due to the instructions the main methods which were used are Proprioceptive Neuromuscular Facilitation and Sensorimotor Stimulation.

Keywords: Stroke, Ischemic, Proprioceptive Neuromuscular Facilitation, Verticalization, Gait, Spasticity, Sensorimotor stimulation, Physiotherapy, Rehabilitation, Treatment.

Declaration

I declare that I wrote my graduation dissertation (bachelor/graduate) independently, and that I have stated all the information sources and literature I used. Neither this thesis nor any substantial part of it has been submitted for the acquisition of another or the same academic degree.

In Prague, ... …… Grandaunt's signature

Acknowledgements

It is an honor for me to have this opportunity to thank the person whom guides me during this work starting by my supervisor Mgr. Kateřina Maršáková. Great thanks to Bc. Tomáš Modlinger for his guidance and advices during my clinical practice at Kladno hospital and his guidance during writing my thesis which I appreciate it.

1. Introduction

This thesis includes theoretical and practical aspects of a case study of physiotherapy treatment. The case study is based on clinical work placement at Kladno Hospital from 26.01.2021-22.02.2021. The case study concerns a 69-years old man, who is after hemiparesis on the left side of the body which occurred on 18 January 2021 which was the result of heart fibrillation. The thesis is divided into two main parts, a theoretical part and a special part. The goal of theoretical part is to know what the stroke is and how to treat it.

The special part deals with the patient and the rehabilitation after the ischemic stroke. It is composed of anamnesis, initial examinations of the patient, short- and long term rehabilitation plans, progression of therapy from day to day. Unfortunately the final examinations and therapy result could not be provided due to patient was diagnosed to COVID 19.

2. General part

2.1 Anatomy of the brain

The human nervous system is the most important structure in human body due to its great functions. It is consists of the central nerve system and peripheral nerve system. As a result of their integration they can provide a wide range of controlling the body starting from receiving stimuli and ending by motoric response. The CNS includes the spinal cord and brain. The brain is counted as a mass of nerve tissues with great integration between them. It has three main regions Forebrain, Midbrain and Hindbrain (Brain, 2016). See the figure 1.

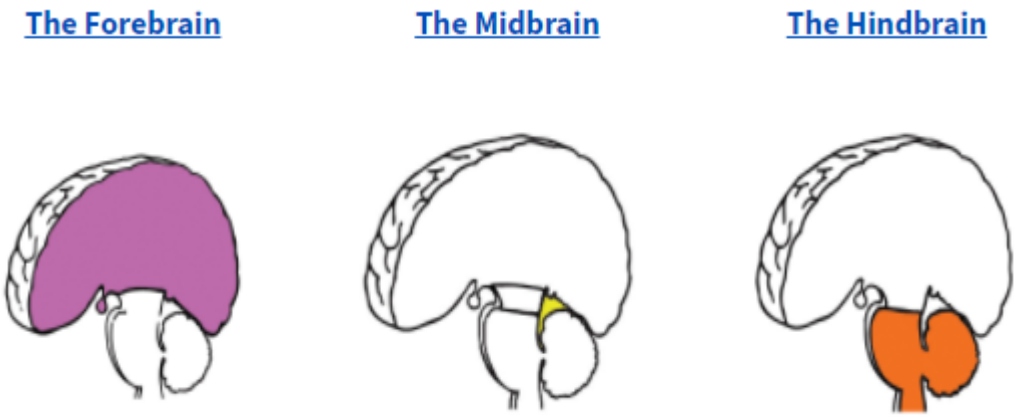

Figure 1: The Architecture of the Brain Forebrain, Midbrain and Hindbrain (Brain, 2016).

The forebrain consists of the external structure Cerebrum and internal structures Hypothalamus, Thalamus and the limbic system. It is consist of left and right hemispheres. The thalamus located in between the medulla and the cerebrum. Hunger, thirst, body temperature, are controlled by the hypothalamus, which also control the pituitary gland by producing hormones (Forebrain, 2016). Midbrain or mesencephalon which located in between the forebrain and the hindbrain is composed of tectum, which is responsible for visual and auditory control where tegmentum is responsible for coordination of sensorimotor information. The midbrain is relatively small in comparison to the forebrain and the hindbrain (Midbrain, 2016). Medulla oblongata, Pons, and

cerebellum are the component of the hindbrain. Midbrain and some parts of the hindbrain, pons and medulla, are called the brainstem. Hindbrain components have different functions separately where is the medulla works mainly as a transmitter between the spinal cord and the brain. The spinal cord and the brain connection is also function of the pons that works mainly as an information transmitter from the cerebrum to the cerebellum due the type of cells group that it contain which are part of the reticular formation controlling alertness, sleep, and wakefulness. A network of neurons extending throughout the brainstem that regulates (Lotha, 2016). Finally the cerebellum and its function. Cerebrum is a part of brain which occupied the most volume and weight of the brain. The cerebrum has two cerebral hemispheres and usually the left hemisphere is the dominant one. These hemispheres have an inner core made by white matter. On the other hand, the gray matter forming the outer cortex of the hemispheres. Basically, the cerebral cortex directs sensory impulses and motoric activities. Around 2,000 cm2 is the surface area of this important part of the brain which differ human beings from other animals. The cerebral has four lobes in each side. Problems analyzing, solving and motor functions are the responsibility of both frontal lobes. Parietal lobes are responsible for sensation, handwriting and position of the body. The ability of hearing and memory are controlled by temporal lobes. The occipital lobes have the system of visual processing. The cerebral region has several ventricles which are interconnected. These ventricles are filled by cerebrospinal fluid located in the both lateral sides of cerebral hemispheres, central and caudal areas of the brain (Forebrain, 2016) see the figure 2.

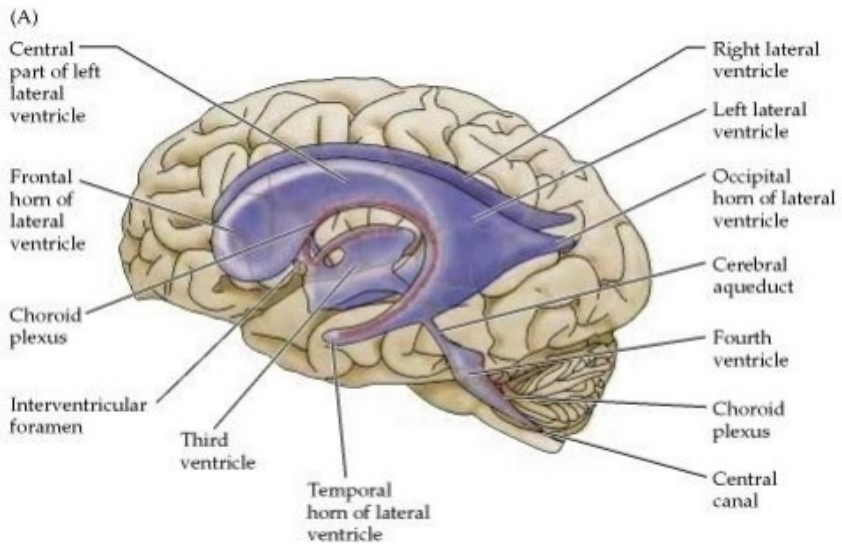

Figure 2: The ventricular system of the human brain (Purves, 2001)

Two arteries which supply the brain are internal and vertebral. Most of the cerebrum is innervated by internal carotid arteries however the cerebellum and brainstem are innervated by the vertebral arteries. Left and right vertebral arteries pass the skull then they form together the basilar artery which meet the internal carotid arteries in the Circle of Willis. The Circle of Willis is counted as a safety feature which prevents the damage of the brain if blockage occurs in major vessels (Hines, 2013). See the figure 3.

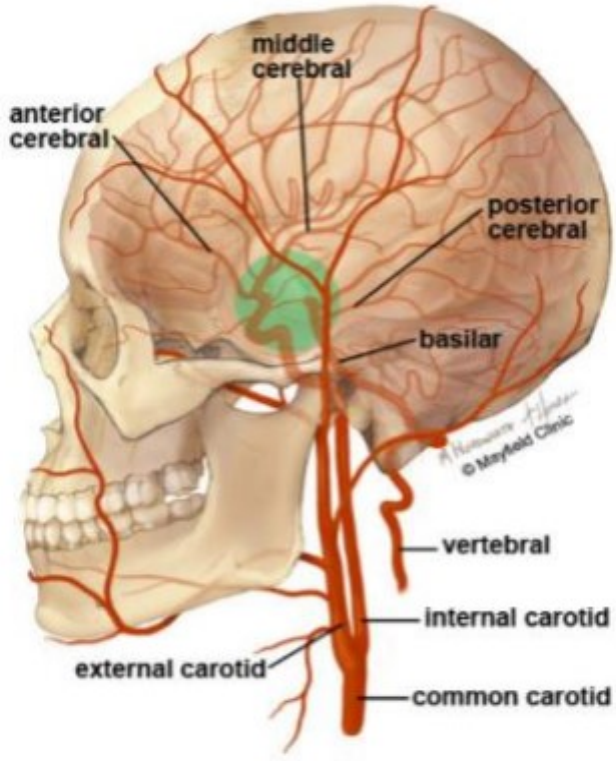

Figure 3: Brain blood supply (Hines, 2013)

2.1.1 Neurophysiology of the brain

The nervous system is composed of neuron cells which receives and sends information and connects brain to the whole body parts. Neurons have various shapes and sizes. Neurons have

three main parts dendrites as input part, cell body and axon as output part. The human brain contains around 100000 million neurons. However, neurons could have different body part according to their location in the body for instance in dorsal root ganglion cells have no dendrites where in the brain cells axons are missing. The connection mechanism between neurons starts by receiving a message through the dendrites in a chemical signal form which called neurotransmitters. Then, dendrites convert a chemical signal to an electric current which runs through the cell body to the end of the axon where its convert back to chemical signal. After that, the neurotransmitters travel to other neuron dendrites passing a small gap called synapse (Hanai, 2005). Axons are usually covered with myelin sheet, a lipid substance which works as an electrical insulator to increase the action potentials conduction. This sheet is formed by Schwann cells (Carpenter and Reddi, 2012). In the cell body, water acquired around 75%. Proteins and lipids have the other 25% of whole body cell. As dendrites work as receptor of the weak electric current (impulses) they have the ability to receive thousands of neurons (Hines, 2013).

Under normal circumstances, brain perfusion is between 50-60ml/100g of brain tissue. Ischemic cerebrovascular accidents develop as a result of significant decrease in brain perfusion in a specific part or all. If the blood flow decreases under 20ml/100g of brain tissue, neuronal function becomes disturbed and clinical signs develop which it stems from ischemic lesion. Hypoxic brain tissue leads to structural changes and ends in brain infarction. The causes of brain ischemia can be either local (i.e., arteriosclerosis, cardiac causes) or systemic (i.e., complete brain hypoxia in pulmonary problems due to increased blood viscosity) (Kolar et al., 2013).

2.2 Types of strokes

Strokes or cerebrovascular accident is a significant decrease of blood in the brain due to interruption in the blood flow which leads to cell death. This situation causes different impairments according to the area in the brain that have been damaged. There are two types of decreased blood flow in brain an ischemic stroke and a hemorrhagic stroke (Kernan et al., 2014).

Blockage in blood vessels occurs due to various reasons as moving blood clot, static clot or arterial dissection can cause an ischemic stroke. The main types of ischemic strokes are:

1. Transient ischemic attack (TIA) in which the signs completely resolve within 24 hours with short neurologic deficit.

2. Reversible ischemic neurologic deficit (RIND) in which the signs resolve more than 24 hours but eventually leaves cosequences.
3. Stroke in evolution in which the signs gradually progress
4. Completed stroke with irreversible and permanent deficits (Kolar et al, 2013).

On the other hand, a hemorrhagic stroke is occur when blood exit from a broken vessel due to a burst in the vessel. This cause a reduction in the blood being transfer to the brain and can cause increase in brain pressure. The main types of hemorrhagic strokes are intra-axial haemorrhage and extra-axial haemorrhage (Rebecca., Stahl, 2015).

2.2.1 Clinical picture

A stroke could be diagnosed using CT or MRI devises. The CT is a radiological technique which shows a three-dimensional scaning picture where is MRI is based on nonradiological technique which provides a special three-dimensional photos. Not like the CT using MRI could help to diagnose the stroke in earlier stages. Stroke patients have different symptoms due to the location of the lesion in the brain. High number of patients diagnosed with stroke have the symptoms for two to three days. Here are some general symptoms which could be present on the stroke patients: Speech disorders as aphasia which is the disability to speak, dysarthria which is speaking difficulty, hemiplegia or hemiparesis which refer to numbness or weakness in one side of the body, visual problems or disability to move or control movement of one eye (rarely both eyes) in specific direction which called as amaurosis fugax, severe headaches, vertigo, dizziness, unexpected falls, vomiting, un-coordination of trunk or limbs movements, tremors, decreasing in sensation ability to heat or pain and hearing difficulties. Patients could fall into a coma, but this symptom is rare (Rebecca., Stahl, 2015; Kernan et al., 2014).

Moreover, there are some specific symptoms in the time of having stroke which could help to diagnose the patient with hemorrhagic stroke where some of patients start to have severe headache and may vomit. Other symptoms they could have are: truncal ataxia, vertigo, dysarthria, pain in nuchal area, consciousness changing or even coma. Some symptoms can be observed during the physical examinations, if the patint was not in a coma and he was fully cooperating in the examinations, following could be seen: limb ataxia, high reflexes, nuchal

rigidity , nystagmus , weakness of facial muscles, difficulty in gait and cardiopulmonary complications . If patient was not cooperative with the examiner we can see some of the following symptoms: respirations rhythm is not regular, extensor plantar responses, abnormal movement of eyes and no corneal and pipillary responses or low responses are present (Stephen., Helmi., 2014). After having a stroke patients could experience some of post-stroke conditions such as pain, urine incontinence, fatigue, dysphagia, seizures or epilepsy, paralysis, hemiparesis, foot drop, spasticity, vision problems. Spasticity start to appear after with low intensity after month and after 3 months patient will have full spastic pattern (Post-Stroke Conditions, 2016).

2.2.2 Ischemia in carotid circulation

During ischemia in the carotid circulation, the internal carotid artery or only its branches can be affected. Based on the location of the injury the signs of different lobes of the brain or deep areas of the brain such as internal capsule could be seen. Ischemia most commonly affects the middle cerebral artery and results in a typical clinical picture.

As a result a contralateral movement deficit dominates which affects mainly the distal upper extremity and face muscles. Most probably, a deficit on opposite side of the body and contralateral visual field deficit such as homonymous hemianopsia are present. A deficit in symbolic functions also occurs, which is a sign of injury to the dominant hemisphere. If the non-dominant hemisphere is involved, it could be seen that the patient is unaware of the severity of their own injury (i.e., hemiplegia) and they act as if the deficit does not exist and they ignore it-this is known as neglect syndrome. Often, the eye deviates toward the affected side and gaze paresis toward the opposite side can be seen. The so called **Wernicke-Mann posture** is present with a typical spastic pattern characterized by following:

- Shoulder depression, adduction and internal rotation
- Elbow flexion and with forearm pronation, wrist and finger flexion
- Lower extremity internal rotation, hip and knee extension
- Foot inversion and plantar flexion lower extremity circumduction during gait

The signs of ischemic involvement of the entire trunk of the internal carotid artery are similar to ischemia in the flow of the middle cerebral artery.

Ischemia in the anterior cerebral artery is also manifested by a contralateral hemiparesis, but the lower extremity is involved more significantly (Kolar et al., 2013).

2.2.3 Ischemia in vertebrobasilar circulation

Here, the vertebral artery, basilar artery or cerebellar and brain stem arteries can be involved.

Ischemia in posterior cerebral artery leads to homonymous hemianopsia on the contralateral side. Most often, contralateral, cortical blindness or various visual problems develop and, sometimes, a deficit in symbolic functions such as gaze paresis and contralateral sensory deficits can be seen. With disruption of cerebellar arteries, **Wallenberg syndrome** develops. It is characterized by involvement of cranial nerve V and a contralateral disturbed sensory deficit in the trunk and extremities. Vestibular signs, swallowing deficits, snoring and hiccups are also present (Kolar et al., 2013).

2.2.4 Spasticity

Spasticity could be seen in neurological disorders such as cerebral palsy, CVA. With these diseases, various structures of CNS suffer an injury. Spasticity needs to be distinguished from other conditions demonstrating increased muscle tone such as rigidity of muscle spasm (Kolar et al., 2013).

Spasticity is defined as an increase muscle tone which is velocity dependent resistance to passive stretch which passively moving an extremity quickly will elicit increased muscle tone, but passively moving the extremity slowly may not elicit increased muscle tone . It can be in form of clasp knife phenomena which has increase resistance only at the beginning or at the end of the movement The main signs of spasticity include the following:

- Decreased muscle strength and amplitude of purposeful motor skills
- Deficit in purposeful and coordinated motor skills
- Clonus

- Associated movements
- Abnormal posturing of extremities
- Increased reflexes (Kolar et al., 2013)

2.2.5 Main types of spasticity in the upper and lower extremity

Types of spasticity in the upper extremity:

- Adductor spasticity of the upper arm
- Flexor spasticity at the elbow
- Pronation spasticity of the forearm
- Flexion spasticity of the hand

Types of spasticity in lower extremities:

- Spasticity of the lower leg muscles leading to the development of pes equinovarus(patient is toe walking)
- Spasticity of the lower leg muscles leading to the development of pes valgus(foot deformity is present and genu valgum is developing)
- Spasticity of the extensor hallucis longus(patient has problem with footwear)
- Extension spasticity in the knee joint(patient makes small steps, falls are frequent)
- Flexion spasticity in the knee joint(ambulation with small steps are difficult)
- Adduction spasticity of the thighs(patient demonstrates scissor-like gait)
- Flexion spasticity in the hip (patient has difficulties with ambulation and standing) (Kolar et al., 2013).

2.2.6 The assessment of spasticity

The Ashworth scale or its modification is two methods used to evaluate muscle tone deficit which grades the spasticity based on the resistance that a spastic muscle shows during passive movement, the only difference between Ashworth scale and its modification is the modification has one more number and its more particular (Kolar et al., 2013).

2.2.7 Ashworth scale

1. No increase in muscle tone
2. A slight increase in tone when affected part is moved passively
3. A more apparent increase in muscle tone, but passive movements can be executed
4. A significant increase in muscle tone, passive movement is difficult
5. The affected extremity is rigid with flexion and extension (Kolar et al., 2013).

2.2.8 Modified Ashworth scale

0. No increase in muscle tone
1. A slight increase in muscle tone, manifested by a catch and release, followed by minimal resistance at the end of the range of motion
1+.A slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder of the range of motion
2. A more apparent increase in muscle tone during movement, the affected body part is easily moved.
3. A considerable increase in muscle tone, passive movement is difficult
4. The affected body part is rigid in a certain position; passive movement is not attainable (Kolar et al., 2013).

2.3 Stroke prevalence

In developed countries such as USA, Canada, Germany, the stroke is the third most common cause of death after coronary heart disease and cancer (Silverman and Rymer, 2016). The death rate from stroke is approximately 34.6%. Another 20% of people who have had poor circulation, have severe disabilities and need constant care. 56% remain with constant disabilities (Aliberti, 2017)

2.3.1 Frequency of stroke subtypes

Ischemic stroke is caused by a lack of blood flow to brain tissue. According to data derived from the Framingham Heart Study, approximately 85% of all strokes are ischemic. Sixty percent of ischemic strokes are atherothrombotic, embolic strokes are caused by a piece of thrombus that migrates from a distant location, causing an occlusion of a cerebral vessel. Embolic stroke accounts for approximately 25% of ischemic strokes. Hemorrhagic stroke accounts for approximately 13% of all strokes which the most common type is intraparenchymal hemorrhage (Mendelow, 2016).

2.3.2 Stroke incidence

Stroke remains an important cause of mortality and morbidity worldwide. The World Health Organization estimates that there are 15 million cases of stroke each year. 5 million will die from the stroke and 5 million will live with long-term disability. Stroke is more prevalent in industrialized nations and is a major health concern in the United States. Approximately 795,000 strokes occur each year in the U.S and American Heart Association (AHA) reported 143,579 stroke-related deaths, making stroke the third most common cause of death behind heart disease and cancer (Kolar et al., 2013).

2.3.3 Risk factors of ischemic stroke

Non modifiable risk factors

The non-modifiable risks factors are vitally important for practitioners to be able to detect early as the failure to take corrective measures increases risk levels. It is thus critical that non-modifiable factors are subjected to comprehensive treatment regimes towards reducing such to a lower risk factor status such as modifiable risk factors. Examples of non-modifiable risk factors include gender, age, family history and race or ethnicity. Age is the most significant risk factor such that for an individual above the age of 55, the stroke rate multiplies by two every ten years regardless of other risk factors (Zhang et al., 2012).

Modifiable risk factors

Modifiable risk factors include hypertension which is considered as contributing to the highest risk of suffering stroke. As such, it is a condition prevalent in about 70 of all reported stroke cases. Stroke risks increase as blood pressure increases regardless of gender. Cigarette smoking is also considered as one major risk factor associated with hemorrhagic and ischemic stroke (Go et al., 2013).

As such, the more cigarettes an individual consumes in a day, the greater the risk of stroke and as such, is higher for the female gender. Diabetes is another potent risk factor for stroke though it increases more risk in women as compared to men. Other identifiable modifiable risk factors include hypercholesterolemia though their association with increasing risk decreases with age. Primary prevention aims at anticipating any major adverse situation relating to health. It is universally embraced that the risk of an individual suffering stroke is founded on lifestyle. The best avenue for preventing stroke in society is through population education. This is seen as the most appropriate means with which to curb risk factor development. As such, positive lifestyle changes are the starting point to stroke prevention and as such, the population should desist from poor dietary habits, smoking, alcohol consumption and inadequate physical activity (Khoury et al., 2013).

Straight forward recommendations should be accorded to population relative to healthy weight loss, decreasing the intake of animal fat and excessive salt intakes, increased physical fitness regimes, cessation from alcohol consumption and smoking (Go et al., 2014).

Secondly, population education should encourage greater involvement from an individual standpoint which can allow for better hypertension detection, atrial fibrillation, and diabetes mellitus in an effort to acquire suitable treatment outcomes (Khoury et al., 2013).

Secondary prevention of stroke involves addressing issues encountered by individuals or patients at the risk of suffering stroke or more specifically, transient ischemic attacks (Go et al., 2014).

Drugs like ticlopidine, aspirin, dipyridamole as well as clopidogrel have been found to be especially efficacious towards the reduction of stroke incidences . Similarly, anticoagulants to manage atrial fibrillation potent within a therapeutic range of about INR 2-3 has been found to be efficient especially in instances where intracerebral hemorrhage levels are lower than 1% per annum . Carotid endarterectomy has also been found to be evidently beneficial to individuals who have recently suffered a transient ischemic stroke, non-disabling stroke, as well as ipsilateral high-grade stenosis relevant to the inner carotid artery (Khoury et al., 2013).

Tertiary prevention relates to inpatient rehabilitation treatment regimes after one has already suffered from a stroke episode . This is carried out with the sole aim of enabling survivors to either recover partially or gain total independence from patient care and lead enhanced qualities of life. It is important to point out that stroke recovery in most cases never becomes complete and as such, about 40% of stroke survivors acquiring care while at home require assistance to continue with day-to-day activities (Go et al., 2014).

2.3.4 Surgical treatment for stroke

1. Treatment with blood thinners must start within 4.5 hours - and the sooner, the better it is. This improves the chances of survival and reduces the complications of the stroke. For this purpose Aspirin is the most proven effective medication for the immediate treatment of ischemic stroke, reducing the likelihood of stroke recurrence. The dose of the drug may vary. Other drugs, blood thinners, such as warfarin (Coumadin) or heparin may also be used, but not for emergency treatment (Deaver, 2014).

2. The Introduction of Tissue Plasminogen Activator (tPA): for some patients with ischemic stroke of great effectiveness would be the early administration (within 4.5 hours from the onset) of tissue plasminogen activator (tPA), which leads to clot dissolution and restoration of blood flow in the blocked artery.In the treatment of ischemic stroke, it is often necessary to carry out procedures that must be performed as quickly as possible. This means to use: the use of tissue plasminogen activator (tPA), with direct delivery to the brain. Surgeons can use catheters for introduction of the drug into the brain (Brott et al., 2014).

Mechanical removal of the clot: surgeons also use a catheter to maneuver in the brain with the mechanical removal of thrombus (Yamaguchi et al., 2013).

Other procedures to reduce the risk of recurrent stroke the doctors may recommend a procedure to open the plaque of the narrowed arteries plaque (Kasner and Gorelick, 2004).

3. Carotid endarterectomy: in this procedure, the surgeon removes the plaque blocking the carotid arteries in the neck. The blocked artery is opened, and the plaque is removed. The procedure can reduce the risk of ischemic stroke. However, carotid endarterectomy itself can also cause a stroke or heart attack, contributing to the formation of a blood clot. To reduce the risk of stroke, doctors use special filters used at strategic points of the blood flow (Lapchak and Zhang, 2017).

4. Angioplasty and stenting: angioplasty is another method of expanding arteries leading to the brain, usually the carotid artery. In this procedure a balloon catheter is used, when blown up enough results in the expansion and contraction of arterial plaques (Lapchak and Zhang, 2017). Most often doctors use stenting for the narrowed arteries inserting special sections of metal tubes (stents), which remain in the artery, preventing its restriction (Yamaguchi et al., 2013). Installation of the stent in the artery of the brain (intracranial stenting) is similar to carotid stenting.

For hemorrhage stroke there are also a number of other treatment alternatives for individuals who have suffered stroke.These treatments enable surgeons and healthcare professionals to arrest situations where patients are suffering from some form of hemorrhage and as such save tissues in the brain from extensive and irreversible damage. One such treatment is referred to as an endovascular procedure and is used in the treatment of particular hemorrhagic strokes. They are preferred by some practitioners as they are not overly invasive and less likely to result in

fatalities. This procedure involves a physician intricately inserting an elongated tube into some major artery either in the leg or arm. The doctor then works to guide this tube to parts where a weak spot or otherwise a broken blood vessel has been pin pointed . The tube is then used in the installation of a device similar to a coil which prevents further bleeding or repairs the damaged vessel. Surgery as a treatment intervention for stroke is necessary where cerebral oedema is detected . Cerebral oedema occurring in the peri lesional or infracted brain tissue quickly leads to unprecedented deterioration and death. Hemicraniectomy is a form of surgical procedure recommended for victims of ischaemic stroke especially where it is deemed as largely life threatening. The procedure is also critical towards enabling patient to relive suffering or even death from space occupying forms of cerebral oedema, such as where the middle cerebral artery is affected. Decompressive hemicraniectomy is the most potent treatment for ischemic stroke patients who suffer brain hemorrhage (Wright et al., 2012).

2.4 Care in the subsequent period, psychosocial aspects

If the patient's disability is severe at the time of discharge from the hospital, the patient cannot be transferred to their home environment and continuity of care needs is to be ensured for such patients (rehabilitation institutes). Having an appropriate home environment is a must and when its provided patient can be delivered to the place.

Problems with moving, dependency to others severely affect the patient’s life. In this stage the help from the Association for Rehabilitation of Persons after Cerebrovascular Accidents plays a great role for patients and their caregivers. Here the main goal is patient’s integration back into the society after stroke (Kolar et al., 2013).

2.4.1 Multimodal sensory stimulation

In many animal experiments, it has been reported that, as compared to the animals trained in the normal environment, stroke animals have a much better neuroplasticity in an enriched environment where animals can simultaneously get cognition, sensation, and movement. These environments in animal experiments are similar to the concepts like multimodal sensory stimulation in the human case. There are some new rehabilitation strategies based on these theoretical backgrounds, which are mirror therapy, action observation, motor imagery, and

virtual reality training. Mirror therapy seeks to create an illusion that makes a paralyzed hand move well, putting a paralyzed hand behind the mirror, and looking at a healthy hand movement in front of the mirror. This therapy is reported to be very effective with stroke patients in the sub-acute phase (Lee, 2017).

2.4.1 Pharmacological intervention for brain plasticity in stroke

Changes in synaptic interaction or cortical excitability are affected by the CNS neurotransmitter. Therefore, numerous studies have focused on strengthening brain plasticity using this neurotransmitter such as glutamate, acetylcholine, noradrenaline, dopamine, etc. Amphetamine and fluoxetine showed an improvement of the motor function of stroke patients, while meantime improved spontaneous speech production in aphasia. There have been studies on levodopa, d-amphetamine, methylphenidate, donepezil, and several antidepressants. Besides, central depressant agents making some decrement of a patient's arousal state such as benzodiazepine, haloperidol, and clonidine have negative effects on rehabilitation treatment due to lowering the excitability of cerebral cortex. Therefore, these agents should be carefully used (Lee, 2017).

2.4.2 Suggestions from current clinical practice guidelines

To improve functional outcome in stroke patients, it is generally recommended that early rehabilitation after stroke be provided by multidisciplinary stroke care team. However, the timing of initiation of rehabilitation is yet to be clarified (Lee, 2017).

2.5 Rehabilitation for a cerebrovascular accident

Therapy uses predominantly a combination of Vojta's method, neurodevelopmental treatment and proprioceptive neuromuscular facilitation. Occupational therapy also has a significant influence. Components of these methods are chosen based on the situation of the patient (Kolar et al., 2013).

2.5.1 Rehabilitation in acute stage of strokes

Rehabilitation in the Acute Stage is the most suitable for management of stroke. The reason is that bed rest has a negative effect on the musculoskeletal, cardiovascular, respiratory, emotional condition and immobilization which might delay recovery in the acute stage of stroke. According to the latest study, depending on the patient's status within 24 h after stroke onset, if a stroke patient performs the set amount of ADL within a certain period, the study group recovers more than the control group in terms of functional improvements 3 months after the onset. After the onset of stroke, in the case of medically stable condition, the early intensive rehabilitation can make the best functional recovery in the long term (Bendok et al., 2012).

2.5.2 Rehabilitation in the sub-acute stage of stroke

In order to manage functional impairment from stroke, sub-acute stroke rehabilitation is crucial. It is recommended that stroke patient should be transferred or admitted to a comprehensive stroke rehabilitation unit where a multidisciplinary approach is available. Including physical and occupational therapy, endurance and strengthening exercises, and flexibility, balance, and coordination training, are performed in the sub-acute stage of stroke. Furthermore, speech/language therapy for aphasia and dysarthria and occupational therapy for dysphagia are added depending on the patient's need (Bendok et al., 2012).

2.5.3 Rehabilitation in the chronic stage of stroke

Patients in the acute or sub-acute phase are mainly managed in hospitals. From 6 months to 1 year after the onset of stroke, it reaches the chronic phase in the event of no more functional recovery. Mostly, there are several basic trainings such as endurance training that reduces general fatigue, balance training to prevent failing accident, and Rehabilitation in subacute and chronic stage after stroke stretching to prevent contracture of both joint and muscle. At the same time, one-to-one individualized training programs are required. Additionally modifying the house or the environment is necessary for the patient (Bendok et al., 2012).

2.6 Orthotic equipment

In any phase of ischemic stroke there could be need for certain type of assistive devices for comfortable standing and moving progression, these aids could have certain affects such as additional support for unstable joints and inhibit the spasticity onset and other secondary changes. They include various types of orthoses and splints, canes, crutches, walkers, etc. There exists for the upper extremities, custom made splints are used to prevent flexor contractures of the fingers and the hand if finger and hand flexor spasticity is more pronounced. On the lower extremity, orthotic devices are sometimes needed to ensure correct foot alignment during gait. The foot of the paralyzed lower extremity often demonstrates calf muscle spasticity and weakness in the anterolateral muscles of the lower leg pre-positions the foot in plantar flexion, which usually affects the gait pattern. At the same time, instability and weakness in ankle joint could be seen by foot in eversion and inversion. In this case elastic bandage and taping can be used however in more severe cases use an ankle joint orthoses is necessary.

In patients after a CVA, some modalities can also be utilized to control pain, decrease spasticity, improve trophicity, reduce edema and improve proprioception. To achieve this, certain aquatic treatment procedures are appropriate (for example, whirlpool). Electrical modalities can be used to control analgesia, such as in shoulder pain. Patients after a CVA who also show a speech deficit need long-term intervention by a speech pathologist. Speech therapy intervention is an integral component of treatment for patients after a CVA (Kolar et al., 2013).

2.7 Main therapy procedure

Sensorimotor stimulation background

Around 1970, Professor Janda and his colleague M.Vavrova began working on methodology of sensorimotor stimulation. At first SMS technique was used during therapy for unstable knee and ankle but nowadays its being used during therapy to restore functional deficit of movement apparatus. This method could be applied during various positions but the most important position is during vertical position because this method emphasizes facilitation of movement from the foot. It increases skin exteroceptors and proprioceptors from muscles and joints. These method

has various kind which performing small foot , practice with balance sandals and balance board could be mentioned.

For performing small foot the initial position is sitting which therapist uses both hands to passively mold the foot to perform small foot and then later on the patient will do it in standing position. During sitting he tries to push the first and fifth metatarsals and heel to the mat and pull the metatarsals to the heel. At this time longitudinal and transverse arch increase.

The main goals during SMS technique are improve muscle coordination, faster initiation of muscle contraction, correction of balance deficits and influence proprioceptive deficits accompanying neurological illnesses (Kolar et al., 2013).

Proprioceptive neuromuscular facilitation

PNF or Proprioceptive Neuromuscular Facilitation was found by the physician and neurologist Herman Kabat who used proprioceptive techniques on neurological patients but mainly on young patients diagnosed with cerebral palsy in 40's. He developed the PNF technique after he found that proximal segments stimulation by stimulating the distal segments. His technique was based on "Sherrington's principles of irradiation, reciprocal innervation and inhibition". PNF has two uses strengthening and stretching techniques where is the stretching techniques are used to effect spasticity (Lee and Heidi, 2013).

There is specific effect on anterior spinal horns of motor neurons through afferent impulses from the muscle, tendon and joint proprioceptors serves as basic neurophysiological principle of PNF. All movement pattern starts in diagonal direction with rotation and resembles majority of ADL and movements in direction of diagonals always contains three movement componenets in different combinations which are flexion or extension, adduction of abduction and external or internal rotation. There are some factors which counts as facilitative approaches which are stimulation through muscle stretch, stimulation of joint receptors, commands from therapist, visual stimulation, manual contact and adequate mechanical resistance in addition, based on the combination of movement patterns there are various types of muscle contractions, strengthening techniques such as repeated contraction and slow reversal and relaxation technique such as contraction relaxation are part of this method.

Indication for PNF are deficits in proprioceptors and skin sensation, muscle hypertonia, muscle weakness, spasticity and contractures while the main contraindications are serious cardiovascular illness, fever, metastaic malignant tumors.

Goals for PNF are improve muscle strength, increased joint stability, improve muscle coordination and increasing range of motion (Kolar et al., 2013).

Conditional training

If patient is immobilized for long term it can accelerate the progression of the disease. The main goals of patient mobilization are to prevent muscle atrophy, degenerative changes in hyaline cartilage, ligaments and joint capsule and osteoporosis. Early mobilization of patient must be initated as soon as possible to prevent the risk of cardiopulmonary strain (Kolar et al., 2013).

Breathing gymnastics

The purpose of breathing gymnastics are to achieve optimal breathing efficiency. There exists three different types of breathing gymnastics which are static, dynamic and mobilization breathing.

Static breathing gymnastics are those exercises without moving of lower and upper extremity. Breathing activity is diected to thorax, abdomen, back and pelvis and it can be provided in sitting or supine position. The respiratory muscles participate in postural function and the quality of respiration and stabilization of spine are closely connected. The deep layer muscles play an Improtant role in the overall respiratory cycle and after breathing gymnastics the stability could be affected too (Kolar et al., 2013).

Patient mobilization

Mobilization could be described as movement activation which could be divided into three phases which are passive movements, active- assistive movements and active movements.

During passive movements patient is completely relaxed and therapist is leading the movements and the goals are help to maintain full ROM, slower onset of spasticity, prevent soft tissue contracture. Active-assistive muscles are those movements with active movement of patient with some help of another person. These movements suits the immobile patients and patients with spasticity. Active movements are those which patient is doing them without any help from others. These types of movements are suitable for increase ROM and strengthening (Kolar et al., 2013).

Repositioing

Can be described as correct position of the patient or body segments in precisely defined positions. It has to be performed on patients with limitation or complete loss of active movement, pathological position, loss of sensation in certain body parts. There are several kinds of repositioning which analgetic, pereventive and corrective could be mentioned.

The position of all segments has to be pain free, comfortable, and allow the patient to do the residual possible movements. Positions has to be performed every 2-3 hours even at night. When the skin blushes the positioning has to be performed every half an hour. The Goals are control of muscle tone, perevention of muscle contracture, perevention of damage to peripheral nerves and elimination of pain.

Basic positions are supine, prone and side lying and special positions such as Fowler's and Trendelenburg position can be mentioned (Kolar et al., 2013).

Verticalization

It can be defined as gradual transion of immobile position into vertical position with use of tilt table or standing frame, here very important factor is measuring heart rate and blood pressure before and after verticalization. Additional care should be considered for patients after hip replacements and thoracic operations which in hip operations the external rotation, adduction and flexion over 90 degrees and in thoracic surgery rotation of trunk has to be avoided. Mobilization goals are prevention of pneumonia, pressure ulcers and muscle contractures it also activates the diaphragm (Kolar et al., 2013).

Vojta's method

This method is used regularly in treatment of neurological illnesses. It plays an important role in treating neurological deficits. It can be used successfully in patient with deficit in consciousness or sensory aphasia.

Therapeutic system of this method is based on developmental kinesiology including individual developmental stages, such as stable supine position. First head lifting in prone , rolling, side sitting, erect sitting, creeping, standing and walking are assessed not only in their final static state, but also how this change from one positionto the next occurs and which muscles are activated in the process.

The method is founded on three movement processes: reflex creeping, reflex rolling, and the process of verticalization. The following movement processes contains basic elements for each forward movement: automatic balance control during movement, body straightening and purposeful grasping and stepping movements of the extremities. The Vojta method is performed in reflexive way or without patient's volitional effort. It sends stimuli to the brain and in this way activates the patient's natural and innate capabilities and it leads to an overall change in body posture.

Professor Vojta based his method on the concept that the basic movement patterns are programmed genetically in each individual's central nervous system. Through reflex locomotion, the CNS can be activated with the goal to renew the innate physiological movement patterns (Kolar et al., 2013).

3. Special part (case study)

3.1 Work methodology

I have done my bachelor thesis placement in Kladno hospital in neurology department.

Patient had 9 sessions of therapy at the morning from 26.01.2021 to 05.02.2021.

My patient was a man after ischemic stroke on right side of the brain which as a result he had hemiparesis on the left side of the body.

The patient has been informed about my thesis practice so we could cooperate and agreed that his personal information, anamnesis and his present situation will be used (see Supplements 4 and 5).

During examinations I have used a measuring tape, plastic goniometry, and neurological hammer. In addition, high walker and spiky balls was used during therapy sessions and examinations.

Due to guidance of my supervisor SMS technique according Janda and PNF according Kabat were followed during my practice.

On 06.02.2021 patient was diagnosed positive to corona virus and he was removed from neurology department and the final evaluation could not be provided.

3.2 Anamnesis

Examined person: V.J

Sex: Male

Year: 1952

Diagnosis: Hemiparesis on the left side of the body

Objective:

Communication: Well socialized

Assistive devices: High walker

Dominant limb: Right side

Glasses: Yes

Height: 190cm

Weight: 130kg

BMI, somatotype: 36

Chief complain /problem: Patient has hemiparesis on the left side of the body after having ischemic attack on right side of the brain in ACI area on 18 January 2021,which was the result of heart fibrillation and now he is having problem with spasticity, instability, muscle weakness , neurological deficits , gait disorder.

PA (history of present problem): Patient was hospitalized on January 18, 2021 due to the repetitive falling on his left side, he was examined for left hip pain, after making x-ray examination of his hip, no trauma signs could be found, but after chest x-ray the effusion or the infiltration of the heart was suspicioned, due to this reason he has been hospitalized on 19th he has been clinically diagnosed with hemiparesis on the left side of the body.

FA (family anamnesis): Patient's father had passed away when he was 13 years old but he doesn't remember the exact reason, mother did not have any specific problem.

IA (injuries anamnesis): None.

Past medical and surgical history: Diabetes mellitus type 2, hypertension, disorder of lipoprotein metabolism.

Past rehabilitation: None.

Medication: Antipyretic and antihypertensive medication.

Orcal 0-0-1, Fenofix 0-0-1, Metformin 1-0-0, Lozap 1-0-0

AA (allergic anamnesis): None.

GA (gynecological anamnesis): None.

Abuses: Smokes 20 cigarettes per day, occasionally drinks alcohol.

Diet: None.

Functional anamnesis: Patient lives with his nephew, in the first floor of a flat without any stairs, he was independent for his household activities such as cooking, washing and shopping. He had no problem with sleeping and sitting.

SA (social anamnesis): Well socialized.

OA (occupation anamnesis, vocation): Retired builder.

Sport, regular physical activity: None.

Hobbies: Watching TV, reading newspaper.

Prior rehabilitation: None.

Excerpt from patient's health care file

CT of the brain

No bearing changes are evident in the posterior cavity of the skull. IV. Chamber appropriately sulfur, in the middle care.

Internal ducts not expanded suprasellar tanks loose. Supratentorial 2 subacute ischemic bearings on the right, F 21x19x23mm and P 17x13x14mm, central structures without displacement.

RHB indications: Verticalization, gait training, rehabilitation of the left limb.

3.3 Initial kinesiological examinations

3.3.1 Neurological examination

Mental status

- Patient is orientated in the time and place point of view.
- No impairment in communication abilities.
- Memorizing ability is physiological.
- Patient is not suffering from dysarthria.

Meningeal sign

- Negative

Cranial nerves

Nerve	Result
1.Olfactory	Not affected
2.Optic	Not affected
3.Oculomotor	Not affected
4.Trochlaris	Not affected
5.Trigeminus	Not affected
6.Abducens	Not affected
7.Fascial	Not affected
8.Vestibulocochlaris	Not affected
9.Glossopharyngeal	Not affected
10.Vagus	Not affected
11.Accessory	Not affected
12.Hypoglosseal	Not affected

Table1: Initial cranial nerves examination

Motor system

Spasticity / rigidity sign:

Based on the examination spasticity was found in Gastrocnemius and Soleus muscles on the left side of lower extremities which was grade 3 according to Ashworth scale.

Rigidity: was not observed.

Sensation

In both sides are intact.

Dermatomes sensation

Dermatomes	Left	Right
C5	Not affected	Not affected
C6	Not affected	Not affected
C7	Not affected	Not affected
C8	Not affected	Not affected
T1	Not affected	Not affected
T2	Not affected	Not affected
T3	Not affected	Not affected
L2	Not affected	Not affected
L3	Not affected	Not affected
L4	Not affected	Not affected
L5	Not affected	Not affected
S1	Not affected	Not affected
S2	Not affected	Not affected

Table2: Initial dermatomes examination

Heat cold and vibration

Symmetrical and not affected on both sides.

Position sense

Not affected in extremities except affected on left knee and ankle joint and right lower extremity only on metatarsal joints on all fingers.

Deep tendon reflexes

Deep tendon reflex	Left	Right
Biceps:C5-C6	Hyper reflex	Hypo reflex
Triceps:C7	Hyper reflex	Hypo reflex
Flexors:C8	Hyper reflex	Hypo reflex
Patellar:L2-L4	Hyper reflex	Hypo reflex
Achilles:L5-S1	Hyper reflex	Hypo reflex

Table3: Initial examination of deep tendon reflexes

3.3.2 Muscle tone palpation

Muscles of Lower extremity	Left	Right
Gluteus maximus	Hyper tonus	Normal tonus
Gluteus minimus	Hyper tonus	Normal tonus
Gluteus medius	Hyper tonus	Normal tonus
Adductor pectineus	Hyper tonus	Normal tonus
Adductor magnus	Hyper tonus	Normal tonus
Adductor gracillis	Hyper tonus	Normal tonus
Adductor brevis	Hyper tonus	Normal tonus
Adductor longus	Hyper tonus	Normal tonus
Sartorious	Normal tonus	Hyper tonus
Tensor facia latae	Hyper tonus	Hypo tonus
Rectus femoris	Hyper tonus	Hypo tonus
Vastus medialis	Normal tonus	Normal tonus
Vastus lateralis	Normal tonus	Hyper tonus
Vastus intermedius	Normal tonus	Hyper tonus
Quardratus lumborum	Hypertonous	Hyper tonus
Paravertebral in lumbar	Hyper tonus	Hyper tonus
Psoas major	Hypertonus	Hyper tonus
Paravertebrals in thoracic	Hypotonous	Hyper tonus
Biceps femoris	Normal tonus	Hypo tonous
Semimembranous	Normal tonus	Normal tonus
Semitendinosous	Normal tonus	Hyper tonus
Gastrocnemious	Hyper tonus	Hyper tonus
Soleous	Hyper tonus	Hyper tonus
Tibialis anterior	Hyper tonus	Hyper tonus
Tibialis posterior	Hyper tonus	Hyper tonus
Proneous longus+ brevis	Normal tonus	Hyper tonus
Extensor Hallucis longus	Hyper tonus	Normal tonus
Extensor Hallucis brevis	Hyper tonus	Hyper tonus
Flexor Hallucis longus and brevis	Hyper tonus	Normal tonus
Abductor Hallucis	Hyper tonus	Hyper tonus
Adductor Hallucis	Normal tonus	Normal tonus
Plantar interossei	Hyper tonus	Normal tonus
Dorsal interossei	Hyper tonus	Hyper tonus
Lumbricales	Normal tonus	Normal tonus
		Normal tonus

Table4: Initial examination of muscle tone, Lower extremity

	Left	Right
Muscles of the UE		
Serratus anterior	**Hypertonus**	**Hypotonus**
Upper trapezius	Hypertonus	Hypotonus
Middle trapezius **Lower trapezius**	Hypertonus	Hypotonus
	Hypertonus	Hypotonus
Rhomboids major	Hypertonus	Normal tone
Rhomboids minor	Hypertonus	Normal tone
Levator scapula	Hypertonus	Hypotonus
Latissimus dorsi	Normal tone	Hypertonus
Teres major	Normal tone	Hypertonus
Teres minor	Normal tone	Hypertone
Supraspinatus	Hypertonus	Hypertone
Infraspinatus	Hypertonus	Hypertone
Pectoralis major	Hypertonus	Hypertone
Pectoralis minor	Hypertonus	Hypertonus
Deltoid whole fibers	Hypertonus	Hypotonus

Table5: Initial examination of muscle tone, shoulder joint

	Left	Right
Coracobrachialis	Hypertonus	Hypotonus
Brachioradialis	Hypertonus	Normal tone
Anconeus	Hypertonus	Normal tone
Triceps brachii	Hypotonus	Hypotonus
Biceps brachii	Hypertonus	Hypotonus
Brachialis	Hypertonus	Hypotonus
Supinator	Hypertonus	Hypotonus
Pronator quadarus	Hypertonus	Normal tone
Pronator teres	Hypertonus	Normal tone

Table 6: Initial examination of muscle tone, upper hand

	Left	Right
Extensor carpi radialis longus	Hypertonus	Normal tone
Extensor carpi radialis brevis	Hypertonus	Normal tone
Extensor carpi ulnaris	Hypertonus	Hypotonus
Flexor carpi ulnaris	Hypertonus	Hypotonus
Flexor carpi radialis	Hypertonus	Hypotonus
Flexor digitorus superficialis	Hypertonus	Normal tone
Flexor digitorum profundus	Hypertonus	Normal tone
Extensor digitorum	Hypertonus	Normal tone
Extensor indicis	Hypertonus	Hypertonus
Extensor digiti minimi	Hypertonus	Hypertonus
Palmaris longus	Hypertonus	Hypertonus
Palmaris brevis	Hypertonus	Hypertonus

Table 7: Initial examination of muscle tone, elbow joint

	Left	Right
Lumbricales	Normal tonus	Normal tone
Palmar interossei	Hypertonus	Hypertonus
Dorsal interossei	Hypertonus	Hypertonus
Abductor digiti minimi	Normal tone	Normal tone
Flexor digiti minimi	Hypertonus	Hypotonus
Opponens digiti minimi	Hypertonus	Hypotonus
Abductor pollicis longus	Hypertonus	Hypotonus
Extensor pollicis brevis	Hypertonus	Normal tone

Table 8: Initial examination of muscle tone, wrist

	Left	Right
Extensor pollicis longus	Hypertonus	Normal tone
Flexor pollicis brevis	Hypertonus	Hypotonus
Flexor pollicis longus	Hypertonus	Hypotonus
Opponens pollicis	Hypertonus	Normal tone
Abductor pollicis brevis	Normal tone	Normal tone
Adductor pollicis	Normal tone	Normal tone

Table 9: Initial examination of muscle tone, metacarpal joint

3.3.3 Specific neurological test

Paretic sign	Left	Right
Mingazzini Upper extremity	Positive	Negative
Mingazzini lower extremity	Not available	Negative
Hanzal	Positive	Negative
Barre	Positive	Negative

Table 10: Initial paretic sign examination

Pyramidal sign

Pyramidal signs	Left	Right
Babinski	Positive	Negative
Oppenhaim	Positive	Negative
Juster	Negative	Negative
Hoffman	Negative	Negative

Table11: Initial pyramidal sign examination

Cerebellum examinations

	Left	Right
Intention tremor	Negative	Negative
Dysynergia	Negative	Negative
Dysmetria	Negative	Negative
Dysarthymia	Positive	Negative
Dysdiadokinesis	Positive	Negative
Dysarthia	Negative	Negative
Taxe upper exteremities	Positive	Negative
Taxe lower exteremities	Not available	Negative

Table12: Initial cerebellum examination

Polysynaptic reflexes

Polysynaptic reflexes	Left	Right
Hautant	Positive	Negative
Dufour	Positive	Negative

Table13: Initial polysynaptic reflexes examination

Involuntary movement examination

Involuntary movements	Left	Right
Athetosis	Not present	Not present
Myoclonus	Not present	Not present

Table14: Initial involuntary movement examination

Superficial reflexes

Abdominal: Hypo reflex on left side, normal on right side.

Cortical sensory system

Kinesthetic sensation: Not affected

Stereognosis: Not affected

Graphstasia: Not affected

Tactile localization: Not affected

Discrimination: Not affected in extremities except affected on left side on the lower leg and right lower extremity only on fingers.

Extra pyramidal signs: Not present

3.3.4 Patient observation

The patient didn't have any injury, nose, ears and mouth without having any discharges.
His left lower extremity was edematic due to heart fibrillation. He did not have any wound which could be connected to diabetes.

3.3.5 Gait examination

Patient has been verticalized by help of three therapists, he was standing by high walker and started to walk slowly for only few steps while therapists were holding him from both sides, and the third therapist was moving his left foot forward. He put most of the weight on his upper extremity and the walker arm. His head was completely protracted and he bended his trunk forward. The steps were short and slow. Patient was not stable without help of therapists and after few steps he was tired and asked us to stop the exercise and return him to his bed.

3.3.6 Postural examination

Basic observation of patient's posture

He was lying in his bed with extended lower extremities and hands were placed beside his body and his spine was straight on the bed without any support or pillow under it. His head was in neutral position. He was limited in ADL such as sitting on the bed, standing and walking however, he was independent for activities such as eating and moving in the bed. He was verticalized by help of three therapists, standing by high walker, two therapists were holding him from right and left and the last one was moving his left foot forward because he could not do it.

Plumb line test: Not available due to patient's lack of stability and general weakness.

Breathing examination

Frequency: 15 breathe per minute

Chest shape: Side to side symmetric chest shape. Distance from the front to the back of the chest (anterior-posterior diameter) less than the size of the chest from side to side (transverse diameter). It has normal chest shape, with no visible deformities (such as barrel chest, kyphosis, or scoliosis). No muscle retractions when breathing

Intensity: inspiration and expiration are equal and there is a pause between inspiration and expiration

Sitting: Breathing pattern starts in abdominal area, continues to lower thoracic and slight movements in upper thoracic were observed.

Supine: Breathing pattern starts in abdominal area continues to lower thoracic and no movement in upper thoracic was observed.

Palpation of the pelvis:

Sagittal plane: Physiological anterior tilt.

Frontal plane: Lateral tilt to the left side.

Transverse plane: Clockwise rotation.

Specific testing of the posture:

Romberg 1: Positive because patient could not stand on his foot independently.

Romberg 2: Positive because patient could not stand with his feet together.

Romberg 3: Positive because patient could not stand with feet together and closed eyes.

Vele test: Grade 4 due to lack of stability and general weakness.

Standing on two scales: Not available

Standing on tip toes: Not available

Standing on heels: Not available

3.3.7 Anthropometric measurement

	Left	Right
Functional length	93cm	93cm
Anatomical length	88cm	88cm
10cm above patella	47cm	47cm
Patella circumference	43cm	40cm
Tibia Tuberosity circumference	40cm	38cm
Calf circumference	40cm	40cm
Ankle circumference	30cm	27cm
Heel circumference	37cm	35cm
MTP circumference	24cm	22cm

Table 15: Initial anthropometric measurement

3.3.8 Range of motions examinations for upper and lower extremities according to Janda

		Left lower extremity					
		AROM			**PROM**		
			Neutral			**Neutral**	
Hip	**S**	0	0	0	20	0	120
	F	0	0	0	40	0	15
	R	0	0	0	45	0	40
Knee	**S**	0	0	0	0	0	110
Ankle	**S**	0	0	0	10	0	45
	R	0	0	0	15	0	30

Table16: Initial range of motion examination of left lower extremity

		Left upper extremity					
		AROM			**PROM**		
			Neutral			**Neutral**	
Shoulder	**S**	10	0	110	15	0	120
	F	90	0	//	95	0	//
	T	5	0	90	10	0	95
	R	50	0	25	55	0	30
Elbow	**S**	0	0	130	5	0	135
	R	50	0	50	55	0	55
Wrist	**S**	60	0	65	65	0	70
	F	10	0	20	20	0	30

Table17: Initial range of motion examination of left upper extremity

		Right lower extremity					
		AROM			**PROM**		
			Neutral			**Neutral**	
Hip	**S**	10	0	120	20	0	130
	F	35	0	10	40	0	15
	R	45	0	35	45	0	40
Knee	**S**	0	0	110	0	0	120
Ankle	**S**	15	0	45	10	0	45
	R	15	0	35	15	0	40

Table18: Initial range of motion examination right lower extremity

		Right upper extremity					
		AROM			**PROM**		
			Neutral			**Neutral**	
Shoulder	**S**	30	0	120	35	0	125
	F	100	0	//	105	0	//
	T	10	0	95	15	0	100
	R	60	0	45	65	0	50
Elbow	**S**	0	0	145	5	0	150
	R	80	0	80	55	0	85
Wrist	**S**	75	0	85	65	0	90
	F	20	0	35	20	0	35

Table19: Initial range of motion examination right upper extremity

3.3.9 Deep stabilization system

Diaphragm test

Patient was trying to push the abdominal cavity and the lower part of the chest against the therapist palpating fingers. The lower part of the chest was expanding laterally and dorsally, the internal costal spaces were widening. The position of the lower ribs in the transfer plane did not change with the activation, only lateral movement of the ribs appeared.

Multifidi

Prone position. While asking patient to activate the multifidi muscles from lumbar area to lower thoracic, upper thoracic.
In all three areas patient had tendency to make isometric contraction of multifidi muscle.

3.3.10 Activity of daily living

- ✓ Brush teeth: Independent.
- ✓ Change clothes: Dependent.
- ✓ Toileting: Dependent.
- ✓ Eat food: Independent.
- ✓ Take shower: Dependent.
- ✓ Wear shoes: Dependent.
- ✓ Move in bed: Independent.
- ✓ Sit on bed: Dependent.
- ✓ Stand: Dependent.
- ✓ Walk: Dependent.

3.3.11 Initial examination conclusion

Due to the patient diagnosis which is ischemic stroke of the right side of the brain which resulted in left hemiparesis of his body the following results has been found in his examinations.

In his neurological examination, positive results have been found in Mingazzini of upper extremity but it could not be provided in his lower extremity due to the paresis. Also Hanzal, Oppenhaim, Disarthymia, Dysdiadokinesis, Dufour, tests were positive in his left side. Based on the two positive test results like paretic and pyramidal signs patient could not walk and provide his gait and all the modification of standing tests were positive.

Babinsky was tested positive on his left side and discrimination tests were positive on left side on the lower leg and right lower extremity only on fingers.

All the deep tendon reflexes were found as hyper reflexia on his left side, both upper and lower extremities which could be explained as a result of ischemic stroke which has central origin.

In his muscle tone palpation examinations most of muscles located in the left side of his body were in hyper tone plus in his anthropometric examination patient has increased circumferences in his patella, tibial tuberosity, ankle, heel and metacarpal phalangeal which could be as a result of heart fibrillation and diabetes that patient has.

Based on hemiparesis and general muscle weakness his range of motion is significantly decreased especially in hip, knee and ankle joint in left lower extremity.

He is dependent to the presence of the therapist and nurses for his activity of daily living such as sitting on bed, standing, and walking.

3.3.12 The goal of short - term therapeutic plan:

1. Maintaining range of motion.
2. Stimulation of the weakened muscles.
3. Strengthening of left lower extremity muscles.
4. Improving of the gait.
5. Increase stability.

3.3.13 Proposed therapy:

1. Conditional training.
2. Manual muscle stimulation. For Gastrocnemius, Soleus, and Hamstring of left LE.
3. Proprioceptor neuromuscular facilitation, bridging exercise.
4. Gait training.

5. Sensomotoric stimulation passively (Small foot).

3.3.14The goal of long - term therapeutic plan:

1. Increase overall fitness.
2. Increase stability
3. Gait training
4. Improve muscle coordination
5. Restore and improve coordination and strength

3.3.15 Proposed therapy:

1. Nordic walking
2. Active perform of small foot on the left foot.
3. Gait training in different forms as side and back walking with more concentration on the left side of the body.
4. Reeducate patient arm and hand movement on the left side of the body.
5. Work on the left leg and left arm with focusing on the functional abilities, griping and writing.

3.3.16 Day by day therapy

Day 1 of the therapy

26.01.2021

Morning

Parts of initial examinations were done.

Day 2

27.01.2021

Present state

Subjective: Patient was feeling tired, moving slowly with no pain.

Objective: Patient was trying to collaborate.

Parts of initial examination were done in the beginning.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Increase activity of the proprioceptors, muscle stimulation of Gastrocnemius, Soleus, and Hamstring.
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm.

Proposal therapy

1. Conditioning training: Passive, semi active and active exercise.
2. Facilitation of the weakened muscles.
3. Proprioceptive neuromuscular facilitation
4. Conditional exercise
5. Gait training and verticalization

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.

The same movements have been provided on the right side of the body by patient actively.

Passive training was applied for the left lower extremity and at the same time patient was doing the active movement in left upper extremity. The same exercise was done on the other side by patient.

2. I used spiky balls on the Gastrocnemius, Soleus, and Hamstring on the left side of the body. He moves it fast in direction of muscle contraction and then asking patient to activate muscle.

3. PNF first diagonal flexion pattern for left lower extremity.
Strengthening technique: repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side.

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

Subjective: Patient felt tired but he was collaborating as much as he could. Passive movement of left lower extremity was done by therapist as he could not do it actively, during stimulation with spiky balls he was trying to activate the muscles but he could not. PNF was demanding for him as he had problem with understanding the details. Throughout conditional training he was doing it but he was very slow and for gait he was trying to move his left foot forward but he could not so he had to ask therapists to help him.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower but he was able to the movements actively in right upper and lower extremity and left upper extremity, throughout the facilitation of muscle he collaborated as he was asked but the muscle was still weak**.** During PNF he was trying his best to collaborate but strengthening technique for repetitive contraction was demanding for him, during conditional exercise he was performing the movements slowly but slight improvement since yesterday. For gait training he

needed the assistance form three therapists which two were on right and left and the last one was moving his left foot.

Day 3

28.01.2021

Present state

Subjective: Patient was feeling sleepy without having pain.

Objective: Patient was not motivated for practicing today.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Increase activity of the proprioceptors, muscle stimulation of Gastrocnemius, Soleus, and Hamstring.
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm.

Proposal therapy

1. Conditioning training: Passive, semi active and active exercise
2. Facilitation of the weakened muscles.
3. Proprioceptive neuromuscular facilitation
4. Conditional exercise.
5. Gait training and verticalization

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.

The same movements have been provided on the right side of the body by patient actively.

2. I used spiky balls on the Gastrocnemius, Soleus, and Hamstring and moved it fast in direction of muscle contraction and then asking patient to activate muscle

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out ofthe bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of three therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides and the last therapist was moving his left foot forward as he was not able to move it, and he walked around his room.

Subjective: He was not motivated to do the given therapy because of lack of sleep. Passive movement of left lower extremity was done by therapist as he could not do it actively, during stimulation with spiky balls he was trying to activate the muscles but he could not. PNF was demanding for him as he had to concentrate on so many factors together. Throughout conditional training he was doing it but he was very slow and for gait he was trying to move his left foot forward but he could not so he had to ask therapists to help him.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity but he was able to do the movements actively in right upper and lower extremity and left upper extremity, throughout facilitation of muscle he collaborated as he was asked but the muscle was still weak, during PNF he was trying his best but strengthening technique for repetitive contractopn was still demanding for him, during conditional exercise he was doingit slowly but slight improvement since yesterday and he could do it in more fluent way. For gait

training he needed the assistance form three therapists which two were on right and left and the last one was moving his left but he was trying to load the left lower extremity and load it more than yesterday.

Day4

29.01.2021

Present state

Subjective: patient was energetic.

Objective: He was asking about the detail of today's therapy.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Increase activity of the proprioceptors, muscle stimulation of Gastrocnemius, Soleus, and Hamstring.
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm.

Proposal therapy

1. Conditioning training: Passive, semi active and active exercise.
2. Facilitation of the weakened muscles.
3. Proprioceptive neuromuscular facilitation
4. Conditional exercise .
5. Gait training and verticalization

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.
The same movements have been provided on the right side of the body by patient actively.

2. I used spiky balls on the Gastrocnemius, Soleus, and Hamstring and moved it fast in direction of muscle contraction and then asking patient to activate muscle.

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: Repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of three therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides and a therapist was moving his left foot forward as he was not able to do it, and he walked around his room.

Subjective: He performed all exercises very well, without pain. Passive movement of left lower extremity was done by therapist as he could not do it actively however there was a muscle shaking but no movement, during stimulation with spiky balls he was trying to activate the muscles but he could not while there was a visible muscle contraction. PNF was demanding for him during the repetitive contraction. Throughout conditional training he was doing it in more fluent way with more repetitions and for gait he was trying to move his left foot forward but he could not so he had to ask therapists to help him however he walked more distance in his room than yesterday.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with no movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. for facilitation of muscle he collaborated as he was asked but the muscle was still weak while he could activate it more, during PNF the muscle strength clearly imoroved but still strengthening technique for repetitive contraction was demanding. Throughout conditional exercise the number of repetitions increased and he was doing it better than yesterday. For gait training he needed the assistance form three therapists which two were on right and left and the last one was moving his left. Today he walked more distance in his room more than yesterday.

Day5

01.02.2021

Present state

Subjective: He was ready to do exercises and already waiting for me in his room.

Objective: He asked me to give him more complex exercises.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Facilitation of Gastrocnemius, Soleus, Hamstring
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm
6. Increase stability, coordination and sensorimotor stimulation.
7. Improve breathing pattern

Proposal therapy

1. Conditioning training**:** Passive, semi active and active exercise.

2. Proprioceptive neuromuscular facilitation

3. Conditional exercise.

4. Gait training and verticalization.

5. Facilitation of the weakened muscles.

6. Sensorimotor stimulation (small foot) on the left foot.

7. Breathing exercise.

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.

The same movements have been provided on the right side of the body by patient actively.

2. I used spiky balls on the Gastrocnemius, Soleus, Hamstring and moved it fast in direction of muscle contraction and then asking patient to activate muscles.

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: Repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side.

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

6. Patient is sitting on a chair, gently squeezing the first and fifth metatarsals of the left foot together. Then, with vibratory movements, the therapist shortens and lengthens the sole of the foot.

7. Patient in supine, therapist put his both hands around patient's upper chest and ask him to breathe under his hand while giving patient slight resistance and during exhalation therapist does the vibratory motion to help the patient to exhale all the air inside his lungs.

Subjective: He is very energetic and asking questions for each therapy and no pain. Passive movement of left lower extremity was done by therapist as he could not do it actively however there was a muscle shaking but no movement, during stimulation with spiky balls he was trying to activate the muscles but he could not while there was a visible muscle contraction. PNF was demanding for him during the repetitive contraction. Throughout conditional training he was doing it in more fluent way with more repetitions and for gait he was moving his left foot forward actively and he walked more distance in his room. After doing SMS he was satisfied with more activity of foot muscles. He was feeling more relaxed after breathing therapy.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with no movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. For facilitation of muscle he collaborated as he was asked but the muscle was still weak while he could activate it more, during PNF the muscle strength clearly imoroved but still strengthening technique for repetitive contraction was demanding.

Throughout conditional exercise the number of repetitions increased and he was doing it better than yesterday. For gait training he needed the assistance form two therapists which two were on right and left but he could actively move his left foot slowly. Today he walked more distance in his room more than yesterday. His breathing pattern is more concentrated on the upper chest and its getting closer to physiological breathing pattern. After doing SMS on him foot arch has increased and he could put more weight on his left foot.

Day6

02.02.2021

Present state

Subjective: Patient asked me to concentrate more on his left foot.

Objective: Patient asked me to give him an exercise so he can start to walk soon.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Facilitation of Gastrocnemius, Soleus, Hamstring
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm
6. Increase stability, coordination and sensorimotor stimulation.
7. Improve breathing pattern

Proposal therapy

1. Conditioning training: Passive, semi active and active exercise.
2. Facilitation of the weakened muscles
3. Proprioceptive neuromuscular facilitation.

4. Conditional exercise.
5. Gait training and verticalization.
6. Sensorimotor stimulation (small foot) on the left foot.
7. Breathing exercise

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation.
Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint. The same movements have been provided on the right side of the body by patient actively.

2. I use spiky balls on the Gastrocnemius, Soleus, Hamstring on left side and moved it fast in direction of muscle contraction and then asking patient to activate muscle.

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: Repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

6. Patient is sitting on a chair, gently squeezing the first and fifth metatarsals of left foot together. Then, with vibratory movements, the therapist shortens and lengthens the sole of the foot.

7. Patient in supine, therapist put his both hands around patient's upper chest and ask him to breathe under his hand while giving patient slight resistance and during exhalation therapist does the vibratory motion to help the patient to exhale all the air inside his lungs.

Subjective: He followed all the exercises well, he is very energetic and asking questions for each therapy and no pain. Passive movement of left lower extremity was done by therapist as he could not do it actively however there was a muscle shaking but no movement, during stimulation with spiky balls he was trying to activate the muscles but he could not while there was a visible muscle contraction and the muscles were stronger than previous therapeutic unit. PNF was demanding for him during the repetitive contraction. Throughout conditional training he was doing it in more fluent way with more repetitions and for gait he was moving his left foot forward slowly but actively and he walked more distance in his room than previous day. After doing SMS he was satisfied with more activity of foot muscles. He was feeling more relaxed after breathing therapy. Patient followed the exercises well.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with slight movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. for facilitation of muscle he collaborated as he was asked but the muscle was still weak while he could activate it more, during PNF the muscle strength clearly imoroved but still strengthening technique for repetitive contraction was demanding. Throughout conditional exercise the number of repetitions increased and he was doing it better than yesterday. For gait training he needed the assistance form two therapists which two were on right and leftbut he was moving his left foot actively but slowly. Today he walked more distance in his room more than yesterday. His breathing pattern is more concentrated on the upper chest and its getting closer to physiological breathing pattern. After doing SMS on him foot arch has increased and he could put more weight on his left foot.

Day7

03.02.2021

Present state

Subjective: Patient had chronic fatigue.

Objective: Patient was not interested to perform exercises.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Facilitation of Gastrocnemius, Soleus, Hamstring
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm
6. Increase stability, coordination and sensorimotor stimulation.
7. Improve breathing pattern

Proposal therapy

1. Conditioning training**:** Passive, semi active and active exercise.
2. Facilitation of the weakened muscles
3. Proprioceptive neuromuscular facilitation
4. Conditional exercise.
5. Gait training and verticalization.
6. Sensorimotor stimulation (small foot) on the left foot.
7. Breathing exercise

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.
The same movements have been provided on the right side of the body by patient actively.

2. I used spiky balls on the Gastrocnemius, Soleus, Hamstring on the left side and moved it fast in direction of muscle contraction and then asking patient to activate muscle.

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: Repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

6. Patient is sitting on a chair, gently squeezing the first and fifth metatarsals of the left foot together. Then, with vibratory movements, the therapist shortens and lengthens the sole of the foot.

7. Patient is supine, therapist put his both hands around patient's upper chest and ask him to breathe under his hand while giving patient slight resistance and during exhalation therapist does the vibratory motion to help the patient to exhale all the air inside his lungs.

Subjective: He was not interested to perform exercises due to lack of energy. All exercises were hard and demanding. Passive movement of left lower extremity was done by therapist as he could not do it, during stimulation with spiky balls he was trying to activate the muscles but he could not due to lack of energy. He could not do PNF due to tiredness. Throughout conditional training he could not perform it and for gait he needed help from three therapists. He could not perform SMS due to tiredness. The best part for him was breathing therapy as he didn't have to do intense work.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with slight movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. For facilitation of muscle he could not perfrom the activation because he was tired. During PNF he could not perform it. Throughout conditional exercise he could not perform it. For gait training he needed the assistance form three therapists again due to lack of energy, two therapists were on right and left side and the last one was putting his left foot forward. Today he walked less distance in his room more than yesterday due to lack of energy. His breathing pattern is more concentrated on the upper chest and its getting closer to physiological breathing pattern. While doing SMS on him, he did not have enough energy to perform the exercise.

Day8

04.02.2021

Present state

Subjective: He was complaining continuously about lack of energy. .

Objective: Chronic tiredness was still there.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.

2. Facilitation of Gastrocnemius, Soleus, Hamstring

3. Strengthening of weaken muscles.

4. Improve overall condition, improve active daily living activities.

5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm

6. Increase stability, coordination and sensorimotor stimulation.

7. Improve breathing pattern

Proposal therapy

1. Conditioning training**:** Passive, semi active and active exercise.
2. Facilitation of the weakened muscles
3. Proprioceptive neuromuscular facilitation.
4. Conditional exercise.
5. Gait training and verticalization.
6. Sensorimotor stimulation (small foot) on the left foot.
7. Breathing exercise

Description of today's therapeutic unit:

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation.

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint. The same movements have been provided on the right side of the body by patient actively.

2. I used spiky balls on the Gastrocnemius, Soleus, Hamstring and moved it fast in direction of muscle contraction and then asking patient to activate muscle.

3. PNF first diagonal flexion pattern for left lower extremity. Strengthening technique: Repetitive contraction. Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

6. Patient is sitting on a chair, gently squeezing the first and fifth metatarsals of the left foot together. Then, with vibratory movements, the therapist shortens and lengthens the sole of the foot,

7. Patient is supine, therapist put his both hands around patient's upper chest and ask him to breathe under his hand while giving patient slight resistance and during exhalation therapist does the vibratory motion to help the patient to exhale all the air inside his lungs.

Subjective: He was not interested to perform exercises due to lack of energy. All exercises were hard and demanding. Passive movement of left lower extremity was done by therapist as he could not do it, during stimulation with spiky balls he was trying to activate the muscles but he could not due to lack of energy. He could not do PNF due to tiredness. Throughout conditional training he could not perform it and for gait he needed help from three therapists. He could not

perform SMS due to tiredness. The best part for him was breathing therapy as he didn't have to do intense work.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with slight movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. For facilitation of muscle he could not perfrom the activation because he was tired. During PNF he could not perform it. Throughout conditional exercise he could not perform it. For gait training he needed the assistance form three therapists again due to lack of energy, two therapists were on right and left side and the last one was putting his left foot forward. Today he walked less distance in his room more than yesterday due to lack of energy. His breathing pattern is more concentrated on the upper chest and now he can move his upper chest during breathing. While doing SMS on him, he did not have enough energy to perform the exercise.

Day9

05.02.2021

Present state

Subjective: Patient felt sleepy and tired.

Objective: Patient was complaining about lack of energy.

Goal of therapy unit

1. Maintain and improve ROM in upper and lower extremities.
2. Facilitation of Gastrocnemius, Soleus, Hamstring
3. Strengthening of weaken muscles.
4. Improve overall condition, improve active daily living activities.
5. Improve the gait, stimulation of the CNS, facilitation of the diaphragm
6. Increase stability, coordination and sensorimotor stimulation.

7. Improve breathing pattern

Proposal therapy

1. Conditioning training**:** Passive, semi active and active exercise.
2. Facilitation of the weakened muscles.
3. Proprioceptive neuromuscular facilitation
4. Conditional exercise
5. Gait training and verticalization.
6. Sensorimotor stimulation (small foot) on the left foot.
7. Breathing exercise

Description of today's therapeutic unit

1. Passive movements on left lower extremity: Dorsal and plantar flexion, inversion and eversion of ankle joint, knee extension and flexion, hip flexion, extension, abduction, adduction, internal and external rotation.

Active movements on left upper extremity: For upper extremity patient still supine, dorsal and palmar flexion, radial and ulnar duction , opposition of fingers, flexion and extension of elbow joint, abduction, adduction fixation slightly, flexion and extension of shoulder joint.

The same movements have been provided on the right side of the body by patient actively.

Exercise was performed in upper and lower extremities.

2. I used spiky balls on the Gastrocnemius, Soleus, Hamstring and moved it fast in direction of muscle contraction and then asking patient to activate muscle

3. PNF first diagonal flexion pattern for left lower extremity.

Strengthening technique: Repetitive contraction

Therapists Ipsilateral hand – on dorsomedial part of the the most distal, contralateral hand – on anteromedial part of thigh above the patella. Patients tries to turn the heel inward, push the toes up and to the big toe, bend the knee, push the lower limb up to the hip to opposite side.

4. Supine, with the help of therapist he goes to side lying on the left side, his feet are out of the bed and he tries to raise his trunk with his own power and assistance of therapist. Patient tries to seat straight on the bed without deviating to the sides, forward and backward.

5. Patient has been verticalized by help of two therapists; he was standing by high walker and started to walk slowly while therapists were holding him from both sides, and he walked around his room, he walked without help of therapists to put his left foot forward.

6. Patient is sitting on a chair, gently squeezing the first and fifth metatarsals of left foot together. Then, with vibratory movements, the therapist shortens and lengthens the sole of the foot,

7. in supine position. Static position was used . Therapist put his both hands around patient's upper chest and ask him to breathe under his hand while giving patient slight resistance and during exhalation therapist does the vibratory motion to help the patient to exhale all the air inside his lungs.

Subjective: He was not interested to perform exercises due to lack of energy. All exercises were hard and demanding. Passive movement of left lower extremity was done by therapist as he could not do it, during stimulation with spiky balls he was trying to activate the muscles but he could not due to lack of energy. He could not do PNF due to tiredness. Throughout conditional training he could not perform it and for gait he needed the help from three therapists. He could not perform SMS due to tiredness. The best part for him was breathing therapy as he didn't have to do intense work.

Objective: ROM did not change at all and it is still limited in hip, knee and ankle joint of left lower extremity however. There is an visible muscle contraction with shaking but with slight movements of the joints, the movements in right upper and lower extremities and left upper extremity improved in all directions. For facilitation of muscle he could not perfrom the activation because he was tired. During PNF he could not perform it. Throughout conditional exercise he could not perform it. For gait training he needed the assistance form three therapists again due to lack of energy, two therapists were on right and left side and the last one was

putting his left foot forward. Today he walked less distance in his room more than yesterday due to lack of energy. His breathing pattern is more concentrated on the upper chest and now he can move his upper chest during breathing. While doing SMS on him, he did not have enough energy to perform the exercise.

Day 10

08.02.2021

Patient was tested positive for COVID 19 and he was removed from neurology department. Final evaluation of patient could not be provided**.**

3.4 Final examinations

Final examinations could not be provided because he was diagnosed to COVID 19.

3.5 Therapy effect evaluation

Final examinations could not be provided because he was diagnosed to COVID 19.

After doing conditional training ROM has clearly improved in all extremities and all joints, especially ROM has been increased in all directions in left lower extremity in toes, ankle, knee and hip and coordination of muscles were improved. Generally his gastrocnemius, soleus and hamstring were in better condition after working with spiky balls than beginning which he was not able to contract them at all also, at the end muscle contraction was visible. After stimulation with spiky balls we used PNF and clearly his mucsles were stronger especially in basic movements of first flexion in direction of flexion, adduction and external rotation, ROM has been increased in all directions in left lower extremity in toes, ankle, knee and hip and coordination of muscles were improved.

After fourth session he was able to change his position from lying to sitting and maintain the position independently with less effort than beginning. For his gait which high walker was used at beginning he needed assistance from three therapists for holding him from sides and putting his left foot forward but from day five only two therapists were required however during last two days he needed the assistance from three therapists again as he was suffering frim chronic weakness and fatigue. During verticalization from the bed his hand and feet were stronger and he

was putting less weight on his upper extremity in comparison to beginning, in beginning most of his weight was on his upper extremity. During gait he was more stable with moving his left foot more fluently from initial days. During first four days of therapy he was not able to move his left foot actively forward while after fifth day he was able to move it actively but unfortunately during his last two days he was not able to move the left foot forward actively.

After performing SMS, activity of his sole foot muscles increased, muscle coordination was enhanced and stability was better than starting. After doing breathing exercise he could move his upper chest and breathing pattern was optimal and this helped him to relax more however during initial days of our therapy he was not able to activate his upper chest

The easiest exercise for patient was breathing exercise as he didn't have to do intense work and he could relax during the therapy while the hardest for patient was PNF as he had to concentrate on so many factors such as my verbal comments, follow the movements with the eyes.

According to examinations and the sessions with patient the most effective therapy that we have done is PNF as it effects several factors at the same time such as strengthening of the weakened muscles, stretching of the shortened muscles, improve coordination , improve proprioceptions while the conditional training as it was very detailed and we were doing it for several days, patient lost his interest and it was boring for him.

Most often patient was interested to exercise, often he was asking questions about given therapy and collaborating as much as he could and he was satisfied with the therapies but unfortunately he always had the chronic fatigue which was a great limiting factor for us.

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5. Supplements

Supplement 1

List of tables

Supplement 2

List of abbreviations

CVA: Cerebro vascular accident

CT: Computer tomography

WHO: World Health Organization

AHA: American Heart Association

CNS: Central nervous system

AVERT: A Very Early Rehabilitation Trial

ADL: Activity of daily living

rTMS: repetitive trans cranial magnetic stimulation

tDCT: Trans cranial direct current stimulation

BDNF: Brain derived neutrophic factor

PNF: Proprioceptive neuromuscular facilitation

ROM: Range of motion

VTE: Venous thromboembolism

AROM: Active range of motion

PROM: Passive range of motion

SMS: Sensorimotor stimulation

MRI: Magnetic resonance imaging

UE: upper extremity

LE: Lower extremity

INR: Internatinal normalized ratio

Supplement 3

List of figures

Supplement 4

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, nařízením Evropské Unie č. 2016/679 a zákonem č. 110/2019 Sb. – o zpracování osobních údajů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na[1] ….. kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem[2] ……

Cílem této bakalářské práce je

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele ..... Podpis: .....

Jméno a příjmení osoby, která provedla poučení[3]..... Podpis :.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta ..... Podpis pacienta: .....

Jméno a příjmení zákonného zástupce[4] .....….

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

Supplements 5
Approval of UK FTVS ethics committee

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 6-Veleslavín

I confirm that this project description corresponds to the plan of the project and, in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 23/01/2021 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.
Members: prof. PhDr. Pavel Slepička, DrSc.
prof. MUDr. Jan Heller, CSc.
PhDr. Pavel Hrásky, Ph.D.
Mgr. Eva Prokešová, Ph.D.
Mgr. Tomáš Ruda, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 065/2021

Date of approval: 25.1.2021

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.
The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee