THE NEUROMUSCULAR ELECTRICAL STIMULATION ASSOCIATED WITH SPEECH THERAPY EXERCICES IN DYSPHAGIA AND DYSARTHRIA AFTER STROKE (CLINICAL CASE)

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Abstract: Dysphagia and Dysarthria are frequent associated with stroke. Approximately 50-78% of patients with stroke associated dysphagia in the first few weeks of illness. The risk of stroke complications increases by the presence of oropharyngeal neurophysiological dysphagia and leads to higher mortality. Dysarthria occurs in case of lack of coordination/or muscle weakness of the face, or tongue and throat muscles and affects understanding and intelligibility. Dysarthria also contributes to the tendency of social self-isolation and the decrease of self-confidence. The treatment directions for oropharyngeal dysphagia and dysarthria included the conventional therapeutic techniques associated with neuromuscular electrical stimulation techniques in order to facilitate swallowing and, also, to increase speech clarity using later cervical and facial electrodes. This case report presents a patient diagnosed with left hemiparesis post stroke, associated with dysarthria and dysphagia, treated with later cervical and facial neuromuscular electro-stimulation, associated with procedures of neurologic rehabilitation for the motor deficit of the left side. The patient evolution includes increased control of fluid ingestion, improvement in diction, voice strength and in the general appearance of the face. The cough associated with dysphagia was also improved. This case is suggestive for understanding the importance of later cervical and facial neuromuscular electro-stimulation in the medical rehabilitation of patients with dysphagia and dysarthria, post stroke.

Keywords: dysphagia, dysarthria, electro-stimulation, stroke, rehabilitation.

INTRODUCTION

Dysphagia is the difficulty in swallowing food and is a complex pathology, which requires a multidisciplinary approach due to the many etiological variants underlying the pathogenic mechanism. This condition can make the swallowing of saliva, as well as the consumption of fluids or medicines, difficult, regardless of their consistency.

Dysphagia is a condition commonly reported after a stroke, but its reported frequencies are very discrepant, ranging from 50% to 78% [1]. The presence of dysphagia is associated with an increased risk of lung complications and even mortality. Early detection of dysphagia in patients with acute stroke reduces not only these complications, but also the length of hospitalization, invariably leading to lower health care costs.

The swallowing muscles are represented asymmetrically in both motor cortices. The stroke affecting the hemisphere with the dominant projection of swallowing results in dysphagia and clinical recovery is correlated with compensatory changes in the previously non-dominant, undifferentiated hemisphere. This asymmetric bilateral representation may explain why some stroke patients are dysphagic and why most patients will regain safe swallowing in a relatively short period of time.

Despite this recovery trend, dysphagia has an increased risk of aspiration pneumonia and is an independent predictor of mortality.

The differentiated evaluation of dysphagia and the evaluation of speech therapy can be done following the "International Classification of Functionality - ICF"[2] algorithm, presented in table 1.
The most common treatment for relieving swallowing difficulties is speech therapy. It has a well-defined role in the evaluation, diagnosis, and management of oropharyngeal dysphagia. The speech therapy goals and interventions for dysphagia depend on the type and nature of dysphagia, the root cause and the need/prefers the patient. Considering the swallowing safety, managing aspiration and preventing complications are a major concern. The general goals of a speech language pathologist working with a patient with dysphagia include:

- a detailed and accurate assessment (there may be several assessments over time) leading to an accurate diagnosis of dysphagia that may aid in differential medical diagnosis.
- ensuring a safe swallowing function (reduction or prevention of aspiration)
- creating an equilibrium between these factors and the quality of life, taking into account the preferences of the patient.
- collaborating with other team members, especially dietitians, to optimize nutrition and hydration.
- stimulation of improved swallowing with oral motor / sensory exercises, swallowing and positioning techniques [4]. The speech therapy intervention is summarized in table 2.

### Table 2 – Frequent interventions [3]

- Changing the food consistency
- Changing the fluid consistency
- Changing the meal strategies
- Indirect changing of swallowing techniques
- Changing the physiology of the swallowing mechanism during swallowing.
- Postural change.
- Improvement of oral hygiene
- Introducing strategies to increase confidence and reduce the fear of suffocation
- Training of the caregivers
Dysarthria is a serious speech disorder. As its name suggests, "difficult articulation" (in Latin "dys" - difficult and "arthron" – articulation), it is characterized by an effortful articulation of phonemes and words by the patient. The speech of a dysarthric is specific and easy to notice: it is monotonous, more or less jerky, with interruptions, sometimes explosive, sometimes very slow and whispered, with more or less joint effort, with dyslalia and nasal speech. Therefore, there are disorders of articulation, phonation, resonance, fluency, rhythm and breathing. Various synkinesis and sudden movements of the body are added. The speech of a dysarthric is usually unclear, confused. The person in cause has the desire to communicate, making efforts in this regard.

The causes of dysarthria are brain lesions, dysfunctionalities of the central neural pathways and disorders of the cranial nerves. Dysarthria is diagnosed relatively easily, because in this case, the speech has its specific characteristics. Absolutely mandatory neurological and otolaryngological examination helps the speech language pathologist to establish the speech therapy diagnosis. The verbal extent of dysarthria is very large, ranging from a polymorphic dyslalia, with articulation disorder – motor coordination, to anarthria, meaning the impossibility to articulate sounds. In the case of pronunciation disorders, it is recommended to do the exercises in front of the mirror. The exercises used for the treatment of dysarthria refers to the gymnastics and myogymnastics of the body and organs involved in pronunciation and specially is indicated to educate the process of breathing and the balance between breathing in and out[5].

The neuromuscular electrical stimulation method. The neuromuscular electrical stimulation (NMES) involves the use of a device that transmits an electrical impulse to the skin, through the electrodes, over the selected muscle groups.

- two electrodes are placed on the skin,
- they connect one to the positive terminal of the source, the other to the negative terminal,
- a current is applied between the two electrodes,
- the electrical stimulation decreases the deeper the targeted muscle.

However, surface electrical stimulation has a major disadvantage in that it cannot separate the muscles it stimulates. NMES is used as a method of treatment. The NMES device includes a portable stimulator with electrodes that are placed on the skin, over the neck and / or facial muscles. Electrical stimulation is used to help muscle toning and activating muscle groups in the process of swallowing rehabilitation. The intensity and frequency of stimulation may vary depending on the level of muscle function and response to treatment. The use of NMES in the treatment of dysphagia has been studied by the Office of Health Technology Assessment (OHTA) [6]. The electrical stimulation device used activates the swallowing process, through electrotherapy and surface Electromyography (sEMG), while providing Biofeedback.

The categories of patients to whom electrostimulation therapy is addressed include, but are not limited to stroke, various neuromuscular diseases (Amyotrophic lateral sclerosis, Parkinson).

By combining electrostimulation therapy with traditional therapy, it is possible to speed up the recovery process, restore functions and help the brain to remap the swallowing process. Under the guidance of a clinician, the patient is partner in an interactive therapy, which helps strengthen the muscle in order to rehabilitate the process of swallowing [7].

SEMG biofeedback helps to increase the effort and duration of swallowing attempts and to improve coordination. It also offers the possibility to objectively evaluate the swallowing function according to certain models [8].

The advantages of using electrostimulation therapy can be summarized as follows:

- it is a safe and effective therapy for patients suffering from dysphagia and dysarthria,
- it is a non-invasive therapy, which helps the swallowing process by using Neuromuscular Electrical Stimulation (NMES),
- accelerates recovery time in restrictive diets,
- helps patients to improve their health and maintain long-term results

- help patients to have a swallowing pattern as functional as possible, with a positive impact on quality of life [9].

The exact placement of the electrodes requires a good knowledge of the location of the muscles and nerves involved in swallowing. The protocol with 4 electrodes, respectively 2 channels, was done by kneading them according to the schemes in figure 1.
Fig. 1 Placement of the 4 electrodes according to the manufacturer's diagrams [10].

The treatment with 2 electrodes, respectively 1 channel can be done by kneading them according to the schemes in figure 2.

Fig. 2 Placement of the 2 electrodes according to the manufacturer's diagrams.

CASE STUDY
The presentation of the following data and images is made with the kind support and consent of the patient.

The case of a 74-year-old man from the urban area is presented, known with left spastic hemiplegia, post ischemic stroke, hospitalized in the Colentina Clinical Hospital, Medical Recovery Department, between 2018, 2nd and 18th of May, for clinical-functional evaluation and establishment of a custom recovery program.

Main diagnosis: Left spastic hemiplegia.
Secondary diagnoses: Sequelae of stroke; Central facial paresis on the left side; Essential hypertension (primary); Atrial fibrillation and flutter; Carotid and vertebral atheromatosis; Bronchial asthma.
Speech therapy diagnosis: Dysphagia. Cerebellar dysarthria.

Evaluation. Following the discussion with the family, it can be noted that the patient cannot drink fluids because he drowns and coughs, the same happens with solid food. The patient may chew, but the mastication is deficient due to the inability to control the food bolus.

Data collected following the evaluation:
Following the functional examination of the phono articulatory apparatus, deficiencies were identified at the level of lingual, mandible, labial motility, coordination of respiratory activity.
The patient has cerebellar dysarthria. The symptomatic picture in this case is as follows: disorders of coordination of the phono articulatory apparatus, poor synchronization of articulatory movements, and asynchrony between the movements of different body segments with implications on speech rhythm, asynchrony in the coordination of articulatory and phonation movements.

The characteristics of the patient's speech are: imprecise articulation, characterized by distortion of consonants and vowels which reflects the inaccuracy of articulatory movements, dysrhythmia of repeated movements in the mandible, face, tongue. Laryngeal movements are also affected: prosodic excess can be characterized by excessive stress, prolonged phonemes, and slow articulation. These disorders can be attributed to insufficient muscle elongation because of hypertension.

The evaluation of the neuromyoarthrokinetic apparatus reveals:
- Left hemiparesis, more vivid osteotendinous reflexes on the left, positive Babinski reflex on the left,
- Left upper limb - plegia motor deficit,
- Left lower limb - predominantly distal paretic motor deficit, pain when mobilizing the left coxofemoral joint,
- The patient maintains a sitting position with support for about 15 minutes, orthostatism possible with bilateral support, walking impossible.

**Treatment.** For a start, we did the voluntary swallowing screening test. We presented him a solid bolus and a liquid bolus. We noticed the ability to self-feed, oral movements during chewing, maintaining the bolus inside the oral cavity, triggering the pharyngeal swallowing reflex, the presence of cough. It was observed that, after ingesting the solid food bolus, the patient began to cough. We let him calm down for a few minutes, then offered him a teaspoon of water. The water flowed from his mouth and he also presented a cough.

With the consent of the patient and the family, we started neuromuscular electrostimulation therapy associated with various types of exercises. We used VitalStim device, in 7 sessions of neuromuscular electrostimulation, 1 per day, lasting 30 minutes - 1 hour.

The first two sessions lasted 30 minutes.

Two channels are being worked on. The electrodes were placed, as shown in Figure 3, as follows:
- Channel 1 - the electrodes are placed above the hyoid
- Channel 2 - the electrodes are placed above the thyroid muscle.

![Fig. 3 Placement of the electrodes](image-url)
This location corresponds to positioning scheme 3B. As can be seen, we used an additional channel for the electrodes attached to the facial muscles. This way, we tried to tone the muscles of the face in order to reduce the rictus on the left side. The current is continuous, flowing for 59 seconds and 1 second pause.

After the second meeting, the family noticed that he no longer drowns when he is given solid food and no longer coughs. When ingesting liquids, the patient coughs and doesn’t keep the liquid inside the oral cavity.

The next 5 sessions lasted 60 minutes. The therapy sessions took place as follows:
- 20 minutes working protocol with a direct current of lower intensity to work the superficial area, having the role to prepare the muscles for the next stage.
- 30 minutes working with customized protocol: 1 contraction for 4 seconds, 8 seconds pause, working at high intensity. During the contraction we work with the patient (lateralization and protrusion tongue movements, exercises to control the food bolus, swallowing exercises).
- For 10 minutes, both channels are located above the buccal branches of the facial nerve, on each side of the face. The oropharyngeal bandage is stimulated.

We also added the third channel above cranial nerve XII to increase the motility of the tongue. Various types of exercises were performed during electrostimulation [11]:

a. lip exercises facilitate the patient's ability to maintain fluids in the oral cavity;

b. tongue exercises are performed in order to manipulate the food bolus and its propulsion through the oral cavity;

c. cheek exercises facilitate the rotational movements of the food bolus;

d. breathing exercises are recommended to improve the strength of the respiratory apparatus;

e. holding tension in the tongue facilitates the condition of the posterior wall of the pharynx;

f. Head-lifting exercises, the anterior movement of the laryngeal complex and the opening of the upper part of the oesophageal sphincter.

Recovery program. A specific, individualized and staged recovery program followed the speech therapy exercises, for which physical-kinetic methods adapted to the case were used. Thus, the treatment includes the following indications:

A. Hygienic-dietary treatment: low sodium, normolipidic and normoglycemic diet, drinking at least 2 l water / day.

B. Medication: Midocalm 150 mg, 1tb / day; Pro-combo, 1tb / day; Polygemma 2ml x2 / day (30 days), dissolved in 100ml water; Blackcurrant extract, 2mlx2 / day (30 days), dissolved in 100ml water, Aspocardin 1 tbx2 / day (15 days / month).

C. Recovery treatment: physiotherapy, Kinesiotherapy, massage.

Physiotherapy:
- US, inferior cervical paravertebral 2’, inferior paravertebral, 0.8 w / cm², 6’;
- Electro stimulation - rectangular currents, 7 min each: left quadriceps muscle, tibialis anterior left muscle, left triceps sural muscle, deltoid left muscle, left common flexor of the fingers muscle, left triceps brachial muscle.

Massage: sedative left limbs. Paraffin: left knee.

Kinesiotherapy: left limb mobilizations, transfer exercises, progressive verticalization, facilitate proprioception techniques to promote voluntary mobility of the left limbs.

**DISCUSSIONS**

**Particularities of the case:**
- Cerebellar dysarthria.
- Dysphagia.

**Results:**
After performing the 7 sessions of later cervical and facial neuromuscular electrical stimulation associated with speech therapy various type of exercises, the following results were observed:
- Improved fluid intake, the patient no longer drowns and coughs after swallowing,
- The patient swallows solid and semi-solid food without difficulty,
- Improving dysarthria (louder voice, clearer words),
- Improvement of the facial appearance by reducing the rictus on the left side and diminishing the asymmetry.

**Prognosis:**
- Favourable for dysphagia and dysarthria; the patient should continue with neuromuscular electrical stimulation 2-3 times / week for about 2 months for better results.

**CONCLUSIONS**
-Evan after the second session of later cervical and facial neuromuscular electrical stimulation associated with exercises for the swallowing function, the patient no longer drowns when he is given solid food and no longer coughs.
After only 7 sessions of later cervical and facial neuromuscular electrical stimulation associated with speech therapy exercises, the patient has a significant improvement of swallowing and word pronunciations.

The neuromuscular electrical stimulation associated with speech therapy exercises was highly effective for these patients with dysphagia and dysarthria after stroke, and the benefits of the method set in early.

REFERENCES
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