Original Article

Correction of cognitive impairment after stroke using translingual neurostimulation.

Alkhanov Farkhad[1], Izbassarova Akmaral[2], Serikbayeva Saltanat[1], Abassova Gaukhar[1], Momynova Tursunay[1], Nurlybayeva Gulnaz[2], Ormanov Talgat[1], Kozhabayeva Parida[1], Tursynbayeva Aigul[3], Kulbayeva Lira[3]

ABSTRACT

Background

Stroke is a major public health problem in many countries around the world. In recent decades, the structure of vascular diseases of the brain has been changing due to the increase in ischemic forms. An important aspect of the quality of life and the possibility of self-care for stroke patients is the recovery of post-stroke cognitive impairments.

Objectives

To determine the effectiveness of using translingual neurostimulation in the recovery period of ischemic stroke in patients with cognitive impairments.

Materials and methods

The study involved 120 patients who had suffered an ischemic stroke between 2023 and 2024. The data was collected by conducting tests on the scales of MMSE, Bartel, NIHSS, Merton and Sutton. The main group included 60 patients who, in addition to comprehensive rehabilitation treatment, underwent translingual neurostimulation with a Neuroport device. In the control group of 60 patients, only standard rehabilitation was performed. The statistical analysis was performed using IBM SPSS Statistics software version 27 (Chicago, Illinois). The Shapiro–Wilk criterion was used to check the normality of the distribution. The comparison of independent groups was carried out using the Mann–Whitney criterion, with the statistical significance level assumed to be □<0.05

Results

The analysis showed statistically significant differences between the treatment methods in the main and control group on all assessment scales, which confirms the superiority of the treatment method in the main group.

MMSE: the median in Group 1 was 4, which is significantly higher than the median in Group 2 (Me=2), which indicates an improvement in cognitive function in Group 1.

NIHSS scale: small scale values indicate a good condition. The median in Group 1 reached -4, and in Group 2-2, which indicates a pronounced decrease in the severity of stroke in Group 1.

Bartell scale: the median in Group 1 was 20, which is twice as high as the median in Group 2 (Me=10), indicating high functional independence in Group 1. Merton-Sutton scale: the median in Group 1 was 10, which is significantly higher than in Group 2 (Me=5), which confirms the advantage of treatment in Group 1.

Conclusion

Translingual neurostimulation is effective, easy to use, and classes can be conducted in a hospital setting and at home after discharge, in the presence of relatives, or on their own.

Keywords

ischemic stroke; cognitive disorders; neuropsychological research; translingual neurostimulation; memory disorders.

INTRODUCTION

Stroke is a serious neurological condition that can lead to profound physical and functional impairments in adults, often requiring comprehensive and individualized rehabilitation strategies to restore independence and quality of life [1].

Across most developed countries, stroke remains a major medical and social challenge because of its high rates of morbidity and mortality. Beyond its immediate health consequences, stroke frequently results in long-term disability, placing a substantial socioeconomic burden on patients, families, and healthcare systems. In addition to motor deficits, many survivors experience cognitive decline. Post-stroke cognitive impairment is diagnosed when cognitive difficulties develop in clear temporal association with a clinically evident cerebrovascular event [2].

Stroke is the second leading cause of death worldwide. Incidence and mortality rates declined in high-income countries between 1990 and 2010. However, in low- and middle-income countries, there was no significant change in incidence and the absolute number of deaths from stroke increased during this time [3].

1. Khoja Ahmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan.
2. Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan.
3. South Kazakhstan medical academy, Shymkent, Kazakhstan.

Correspondence

Abassova Gaukhar - Candidate of Medical Sciences, Associate Professor, Head of the Department of Neurology, Psychiatry, Narcology, Khoja Ahmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan. Scopus ID 57189509556, E-mail: gaukhar.abassova@ayu.edu.kz, gaukhar_65@mail.ru.

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The past two decades (1990-2019) have seen a 70% increase in the absolute number of stroke cases, an 85% increase in total strokes, a 43% increase in stroke deaths, and a 32% increase in disability-adjusted life years (DALY) [4].

In 2021, there were 93.8 million (89.0–99.3) prevalent and 11.9 million (10.7–13.2) cases of stroke. Worldwide, ischemic stroke accounted for 65.3% (62.4–67.7), intracerebral hemorrhage for 28.8% (28.3–28.8), and subarachnoid hemorrhage for 5.8% (5.7–6.0) of all stroke cases. Of the stroke cases, 6.3 million or 52.6% (52.4 to 53.1) were in men and 5.7 million or 47.4% (47.3 to 47.6) were in women [5].

Post-stroke cognitive impairment should be understood as any cognitive impairment that is temporally related to the stroke, i.e., within the first 3 months or more after the stroke, but not later than 1 year after the stroke. The later cognitive impairment is detected after a stroke, the less likely it is to be directly related to the stroke [6,7,8].

In patients with stroke and moderate cognitive impairment, ginkgo biloba (120 mg of tanakan per day), piracetam (1200-2400 mg of nootropil per day), choline alfoscerate (120 mg of gliatilin per day) and other nootropic drugs can be used as medications. In cases of pronounced cognitive impairment (dementia), the use of central acetylcholinesterase inhibitors (galantamine) or akathinol memantine (20 mg per day) is justified, as they improve cognitive functions in dementia of various genesis [9,10,11].

Acetylcholinesterase inhibitors reduce cholinergic deficits that occur against the background of damage to central cholinergic structures[12].

Treating stroke and cognitive impairments imposes large direct and indirect economic costs [13].

The disadvantage of these drug treatments is that they take a long time to achieve results and create difficulties for patients due to their financial situation [15].

According to K. Cicerone et al. [14], cognitive rehabilitation is the best form of treatment for patients with cognitive impairment and functional limitations after brain injury and stroke.

The purpose of the study. To determine the effectiveness of translingual neurostimulation in the recovery period from ischemic stroke in patients with cognitive impairment.

MATERIALS AND METHODS

The study involved 120 patients with ischemic stroke who underwent rehabilitation treatment at City Clinical Hospital No. 1 and City Hospital No. 2 of Shymkent between 2023 and 2024. All patients were divided into two groups: main (First), control (Second). Data were collected by testing on MMSE, Barthel, NIHSS, Merton and Sutton scales. The main group included 60 patients who, in addition to comprehensive rehabilitation treatment, underwent a course of translingual neurostimulation with the Neuroport device. The control group, which consisted of 60 patients, underwent only standard rehabilitation.

Patient inclusion criteria: Patients aged 40 to 75 years with cognitive impairment who have had an ischemic stroke.

Exclusion criteria: patients with severe cognitive impairment (MMSE <20 points) and speech impairment, severe somatic pathology, and epilepsy.

Ethical approval for this study was obtained from the Ethics Committee of the Khoja Ahmet Yassawi International Kazakh-Turkish University and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients to participate in this research study.

Neurological status was assessed using the NIHSS scale. Cognitive status was assessed using the Mini-mental state examination (MMSE). Translingual neurostimulation was administered to patients for 20 minutes over 10 days.

Statistical analysis was performed using IBM SPSS Statistics 27 (Chicago, Illinois) software. The Shapiro-Wilk test was used to test for normality of distribution. Comparisons of independent groups were performed using the Mann–Whitney test, with a statistical significance level of $p<0.05$. Descriptive statistics for numerical values are presented as median and interquartile range (Me [P25; P75]).

Ethical clearence

This study was conducted in accordance with ethical standards. Ethical approval was obtained from the appropriate institutional review board, and informed consent was secured from all participants prior to data collection.

RESULTS AND DISCUSSIONS

The results of the Shapiro–Wilk test for all scales studied were p=0.001, where P<0.05 indicates a distribution that differs from a normal distribution.

The values of the nonparametric Mann–Whitney test were also □=0.001 where □<0.05, indicating statistically significant differences between groups.

Comparison of treatments in the main and control groups

The analysis showed statistically significant differences between Treatments 1 and 2 on all rating scales, confirming the superiority of Treatment 1.

MMSE: The median in group 1 was 4, which is significantly higher than the median in group 2 (Me=2), indicating improved cognitive function in group 1 (Table 1).

NIHSS: Smaller scale values indicate a better condition. The median in group 1 was -4, and in group 3 it reached -2, indicating a clear reduction in stroke severity in group 1.

Barthel Scale: The median in Group 1 was 20, which is twice the median in Group 2 (Me=10), indicating higher functional independence in Group 1 (Table 2).

Merton and Sutton: The median score in group 1 was 10, which is significantly higher than in group 2 (Me=5), confirming the superiority of treatment 1.

The treatment method in group 1 showed a significant superiority over group 2 in all assessment scales.

CONCLUSION

Correction of cognitive functions using translingual neurostimulation in patients during the recovery period from ischemic stroke has an effect on improving cognitive function.

Our study showed that translingual neurostimulation is a simple and affordable method for restoring cognitive impairment in patients during the recovery period of ischemic stroke. The complex correction of motor and cognitive deficits contributes to effective recovery.

Translingual neurostimulation is effective, easy to use, and can be performed in the hospital and at home after discharge, with the participation of relatives or independently.

Table 1. Test results in the main group before and after classes with translingual neurostimulation

Scales	Before treatment	After treatment	Difference in values before and after classes	P-value
MMSE	23[23;24]	27[27;28]	+4	< 0.001
Bartel	65[65;70]	85[80;90]	+20	< 0.001
NIHSS	12[11;12]	8[7;8]	- 4	< 0.001
Merton and Sutton	44[44;45]	54[52,5;56]	+10	< 0.001

Table 2. Test results in the control group at the beginning and at the end of the observation period

Scales	Before treatment	After treatment	The difference in indicators at the beginning and end of observations	P-value
MMSE	24[23,5;24]	26[26;27]	+2	< 0.001
Bartel	65[55;70]	75[65;80]	+10	< 0.001
NIHSS	12[11;14]	10[9;11]	- 2	< 0.001
Merton and Sutton	43[40;44]	48[45;50]	+5	< 0.001

Conflict of Interest: The author declare no conflict of interest.

Authors's contribution

Data gathering and idea owner of this study: .Alkhanov Farkhad, Izbassarova Akmaral

Study design: Serikbayeva Saltanat, Abassova Gaukhar

Data gathering: Momynova Tursunay, Nurlybayeva Gulnaz,

Writing and submitting manuscript: Ormanov Talgat, Kozhabayeva Parida,

Editing and approval of final draft:Tursynbayeva Aigul, Kulbayeva Lira

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