IMPORTANCE OF AN EARLY REHABILITATION PROGRAM FOR HEMIPLEGICS AFTER CEREBROVASCULAR INSULT

Aleksandra Jurisic Skevin, Milorad Jevtic, Miodrag Veljkovic, Vesna Grbovic Markovic
Center for Physical Medicine and Rehabilitation, Clinical Center Kragujevac, Kragujevac, Serbia

ABSTRACT
The early rehabilitation of the hemiplegic patients after cerebrovascular insult (CVI) includes a number of measures for motoric, mental and social re-education of a patient. The aim of this study was: establishing a program for the early rehabilitation of the hemiplegic patients after CVI in Clinical Center “Kragujevac”, optimization of time for starting the rehabilitation of hemiplegic patients after CVI and monitoring of the early rehabilitation program effects. The research included 30 patients with hemiplegic syndrome after the first CVI, hospitalized within the first 24 hours of a CVI occurrence, who were subjected to the early rehabilitation program. The control group included 30 patients with hemiplegic syndrome after the first CVI, hospitalized within the first 24 hours of a CVI occurrence, who were subjected to the classical rehabilitation program. The mean treatment duration was 10.5 ± 3.2 days in the experimental group patients and 12.8 ± 4.1 days in the control group patients. There was a significant statistical difference in time elapsed from a CVI to appearance of spasm on the plegic extremities for the experimental and the control group of patients, 6.07 ± 2.39 days and 9.43 ± 3.68 days, respectively (p < 0.001). The time elapsed from a CVI to appearance of the active movements on the plegic extremities was statistically significantly different between the experimental group (5.73 ± 2.5 days) and the control group (9.67 ± 3.58 days) (p = 0.014). The time needed for establishing balance in the sitting position for the experimental and control group were 8.81 ± 2 days and 12.92 ± 3.68 days, respectively (p = 0.001). The application of the early rehabilitation program for hemiplegic patients after a CVI favorably impacts the course and final outcome of the treatment.

INTRODUCTION
Cerebrovascular insult (CVI) is the most common nosological entity within the cerebrovascular diseases (CVD). Due to its incidence, high mortality rate and severity of disability of the survivors, it represents a great and very difficult problem, not only medical, but also social and economic one (1).

Mortality varies from 63.5 to 273.4 deaths per 100.000 inhabitants per year. The highest level of mortality is in the first month and it is 22,9%. Relapses are very frequent for the survivors, approximately 25-50% and they include much more difficult clinical forms and higher mortality. Disability of the survivors (due to the neurological, mental and most often combined damages) is very severe, too (1).

Contemporary doctrinal views insist on implementation of the early rehabilitation and physical treatment of the hemiplegics after a CVI while they are on the neurology ward, within the “Stroke unit” (2). The second phase is the treatment at the rehabilitation wards, or at the rehabilitation institutions. The third phase is the patient’s re-integration in his/her previous social and, depending on the level of his/her recovery, possibly working environment.

The early rehabilitation program of the hemiplegic patients after cerebrovascular insult includes a number of measures for not only motoric re-education, but also mental and social re-education of a patient (3). The early rehabilitation program of these patients focuses on prevention of the skin problems, respiratory, cardiovascular and locomotive systems' complications, as well as on timely, successful functional recovery. The program of the early rehabilitation after CVI is widely accepted around the world, and in Serbia it has been practiced since the beginning of '90s (4). In this study we want to identify the problems which caused that the early rehabilitation program of the hemiplegic patients after cerebrovascular insult was not implemented in the Clinical Center, and...
to find the way to overcome these problems. The present system of care for stroke patients does not meet the needs and is not in accordance with the modern trends in Europe and elsewhere in the world. Thus, there is a real need of the system restructuring. One of the options might be the development and implementation of the National project of stroke prevention and treatment, based on the model of other transitional countries in Europe that have faced similar problems and epidemiological parameters. After publishing the results of our study, this program has been introduced in the Clinical Center Kragujevac.

The aim of our study was: 1) establishing a program for the early rehabilitation of the hemiplegic patients after CVI in Clinical Center Kragujevac, 2) optimization of time for starting the rehabilitation of hemiplegic patients after CVI and 3) monitoring of the effects of the early rehabilitation program applied on the hemiplegic patients after CVI.

PATIENTS AND METHODS

The study lasted one-year, with prospective design, and included 30 patients with hemiplegic syndrome after a CVI, hospitalized in the Center for Neurology of the Clinical Center Kragujevac between March 2000 – February 2001, who were subjected to the early rehabilitation program. The control group consisted of 30 patients with hemiplegic syndrome after a CVI, hospitalized in the same institution in the same period, who were subjected to the classical rehabilitation program. All of 60 patients met the following criteria: it was their first CVI and they were all hospitalized within the first 24 hours of a CVI occurrence. The exclusion criteria were the presence of contraindications for the physical agents, including exercise or electrotherapy (fever, acute or subacute thrombophlebitis, acute infectious disease, chronic heart failure). Patients with severe dementia or those with another disability or debilitating disease that could affect their recovery were excluded. The patients were homogenized by gender, age, occupation, risk factors, plegic side, CT of the brain, clinical status, general somatic status and cerebrospinal fluid analysis. Before enrolment, study participant or their legal representative (close family member) gave informed consent. In addition, the patient’s neurologist in charge, assessed eligibility of the neurological (clinical) status and also gave consent for study participation. Therefore, the study design followed naturalistic concept. If the patient, according to the routine clinical criteria was not eligible for early rehabilitation procedures, as designed by the study protocol, he or she was automatically allocated to control group.

Diagnosis of hemiplegia and CVI was established using well-known criteria: clinical status, neurological findings, computerized tomography (CT) of the brain, lumbar puncture, laboratory analysis, examination of general somatic status, ophthalmological assessment, etc. (5). Patients’ data, important for the research, were taken by interview or from the medical history, and separate records were kept for each individual patient on a daily basis.

In order to have adequate physiatric diagnostics, standardized forms were established and they included: epidemiological data, general status, neurological findings, functional status and additional analysis (CT of endocranium within the first 48 hours from an insult and control CT from 3 to 21 days from CVI; laboratory analysis; cerebrospinal fluid analysis; examination of a fundus).

Based on the above mentioned parameters, the early rehabilitation program was created and carried out for each individual patient from the experimental group, starting 48 hours after stabilization of the patient’s general and neurological status (6, 7). The program was planned and carried out by a team, with the adequate medical therapy and hygiene/diet. The team consisted of: a physiatrist, physiotherapist, nurses, doctors of other specialties as consultants (neurologist, internal medicine specialist, psychiatrist, ophthalmologist, and radiologist), patient’s family members and patient himself/herself.

The early rehabilitation program for the hemiplegic patients after CVI that we implemented in the Center for Neurology at the Kragujevac Clinical Center included: general care and functional training (kinesitherapy and electrotherapy). The care was focused on prevention of numerous complications: decubitus, deep vein thrombosis, hypostatic pneumonia, urinary infection, contracture. Primacy of the functional training was patient’s early mobilization (8). It was achieved by kinesitherapy and electrotherapy procedures which activate as many motoric models as possible, and change already present abnormal motoric models. The main aim of the physical and rehabilitation treatment was to prevent contractures and to lift the patient into standing position as soon as possible (9). The following kinesitherapeutic procedures are used (Bobath, Kabat, etc.): a) corrective position in bed with changing positions several times during the day, b) passive movements at first and then assisted and active voluntary movements in bed for the paralyzed side later, c) active exercises for all segments of the healthy half of the body, d) resistance at the healthy side (irradiation), e) using the symmetric and asymmetric neck reflex, f) using the sinkinesis, g) establishing balance in the sitting position (carefully due to the danger of circular imbalance in the brain), h) exercises of getting up from the bed and exercises of balancing in the standing position, i) with the lower extremities, the emphasis is placed on strengthening the experimental stabilizers of the upright position (gluteus maximus muscle and quadriceps femoris muscle).

The permanent stimulation of afferent ways is also implemented: audio (through constant talking to the patient), cutaneous (stroking, pinching, rubbing of the paralyzed extremities), proprioceptive (changing the positions of the extremities) (8, 9). The same combination of electrotherapy was applied per subject: functional electrical stimulation and longitudinal stable galvanization. Functional electrical stimulation was applied on the gluteus maximus muscle, quadriceps femoris muscle,
tibialis anterior muscle and extensors of the hand on the plegic extremities (SP form of exponential currents was used, duration impulse 10ms, duration pause 20ms, 10 series with 10 contractions per series (10). Longitudinal stable galvanization (SG) was applied along the plegic extremities, lasting daily for 15 minutes. Their dosage was adjusted according to the clinical need of the individual patient (8).

The physical and rehabilitation treatment of patients from the control group in the acute stage was limited to the medical care. The rehabilitation program was limited to only classical kinesitherapy, which was supposed to prevent contractures, infective hypertrophy or muscle atrophy and preserve elasticity of the muscles and other soft structures of the ankles. The program did not include implementation of the electrotherapy. The kinesitherapy was applied two to three weeks after the insult.

Statistical analysis

All values are expressed as mean ± standard deviation (SD). Commercial SPSS (Statistical Package for the Social Sciences) version 11.0. for Windows was used for the statistical analysis. Statistical evaluation was performed by Student’s T-test for paired observations, one-factorial and two-factorial analysis of variance. The differences were considered to be significant when p value was less than 0.05 and highly significant when p value was less than 0.01.

RESULTS

Demographic and clinical data of the experimental and control group of patients were similar (Table 1). Concerning medical treatment, all patients were treated according the institutional protocol for acute stroke. Therefore, there were no important or significant differences between groups in medication (11).

The number of patients with spasticity was significantly different between the experimental and control group of patients (c2-test; p<0.01). The analysis showed that in the group of patients with CVI who were subjected to the early rehabilitation program, 100% of patients (30 patients) had spasticity on the plegic extremities, while in the control group of patients with CVI who were subjected to the classical rehabilitation program, 76.7% of patients (23 patients) had spasticity. Statistically significant difference in the time elapsed from a CVI to the spasticity on the plegic extremities was noted between the patients from the experimental and control groups (t-test; p=0.001). There was a significantly longer time to the spasticity in the control group of patients with CVI with classical rehabilitation treatment (9.43 ±3.65 days), than in the experimental group of patients with applied early rehabilitation treatment (6.07 ±2.39 days) (figure 1).

Table 1. Baseline characteristics of study patients.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Experimental group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>13 (43.3%)</td>
<td>12 (40%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>17 (56.7%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>67.63±6.97</td>
<td>67.23±9.01</td>
</tr>
<tr>
<td>Profession</td>
<td>Housewife</td>
<td>Farmer</td>
</tr>
<tr>
<td></td>
<td>13 (43.3%)</td>
<td>4 (13.3%)</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>4 (13.3%)</td>
</tr>
<tr>
<td></td>
<td>Pensioner</td>
<td>9 (30%)</td>
</tr>
<tr>
<td></td>
<td>Worker</td>
<td>4 (13.3%)</td>
</tr>
<tr>
<td>Risk factors</td>
<td>Without</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>21 (70%)</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td></td>
<td>Drinking</td>
<td>1 (3.3%)</td>
</tr>
<tr>
<td></td>
<td>Smoking</td>
<td>1 (3.3%)</td>
</tr>
<tr>
<td>Side of plegia</td>
<td>Right</td>
<td>18 (60%)</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>12 (40%)</td>
</tr>
<tr>
<td>Type of CVI</td>
<td>Thrombosis</td>
<td>20 (66.7%)</td>
</tr>
<tr>
<td></td>
<td>Haemorrhagia</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td></td>
<td>Thromboembolism</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>CT findings</td>
<td>Ischaemia</td>
<td>25 (83.3%)</td>
</tr>
<tr>
<td></td>
<td>Haemorrhagia</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>Eye fundus</td>
<td>Normal</td>
<td>9 (30%)</td>
</tr>
<tr>
<td></td>
<td>Hypertonicus</td>
<td>12 (40%)</td>
</tr>
<tr>
<td></td>
<td>Arteriosclerotic</td>
<td>9 (30%)</td>
</tr>
<tr>
<td>CSF</td>
<td>Liquid</td>
<td>25 (83.3%)</td>
</tr>
<tr>
<td></td>
<td>Hemorrhagic</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>Speech disorder</td>
<td>Without</td>
<td>4 (13.3%)</td>
</tr>
<tr>
<td></td>
<td>Dysphasia motoria</td>
<td>17 (56.7%)</td>
</tr>
<tr>
<td></td>
<td>Aphasia sensoria</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td></td>
<td>Aphasia motoria</td>
<td>6 (20%)</td>
</tr>
<tr>
<td></td>
<td>Aphasia sensoromotia</td>
<td>1 (3.3%)</td>
</tr>
</tbody>
</table>

The values represent the number of the patients and percent (%); age in the mean years +/- standard deviation (SD)

Figure 1. The time elapsed from a CVI to the spasticity on the plegic extremities in the experimental and control group patients.

Statistically significant difference was found between the patients from the experimental and control groups in the number of patients with active movements on the plegic extremities: 30 patients in the experimental group and 21 patients in the control group had active movements (c2-test; p<0.001). The time elapsed from CVI to the active movements on the plegic extremi-
ties was statistically different between the experimental group (5.73±2.5 days) and the control group of patients (9.67±3.58 days) (t-test; p=0.014) (figure 2).

Figure 2. The time elapsed from CVI to the active movements on the plegic extremities in the experimental and control group patients.

Statistically significant difference was found in the number of patients with established balance in the sitting position between experimental and control group of patients with CVI, but with different method of treatment: 27 patients in the experimental group and 13 patients in the control group established balance in the sitting position (c2-test; p<0.001). The sitting position balance took much longer time in the control group (12.92±3.68 days), than in the experimental group with the applied early rehabilitation program (8.81±2 days) (t-test; p=0.001) (figure 3).

Figure 3. The time needed for establishing a balance in the sitting position in the experimental and control group patients.

There was a statistically significant difference in the number of patients with established balance in the standing position: 17 patients in the experimental group and no one in the control group established balance in the standing position (c2-test; p<0.001). The average time needed for establishing the standing position balance in the experimental group of patients, with the applied early rehabilitation program, was 12.12±2.8 days.

DISCUSSION
Prior to the introduction of the early rehabilitation program for the hemiplegic patients after the CVI, the treatment of these patients in the acute stage was limited to the medical care and measures which had a goal to prevent the existing condition to get worse. The rehabilitation program was limited to only classical kinesitherapy, which was supposed to prevent contractures, infective hypertrophy or muscle atrophy and preserve elasticity of the muscles and other soft structures of the ankles. The program did not include implementation of the electrotherapy. The kinesitherapy was applied relatively late, in the case of hemorrhagic form of CVI, even three weeks after the insult. Such incomplete rehabilitation program could not prevent numerous complications, nor enable adequate motoric and psychosocial re-education (4).

The early rehabilitation program that we implemented on the experimental group of patients included general care and functional training (kinesitherapy and electrotherapy) (12). The care was focused on prevention of numerous complications: decubitus, deep vein thrombosis, hypostatic pneumonia, urinary infection and contractures. The main aim of the physical and rehabilitation treatment is to prevent contractures and to lift the patient into standing position as soon as possible (2, 7, 9). Within the electrotherapy, functional electrical stimulation was applied of the specific muscle groups (10) and stable galvanization (SG) along the plegic extremities (8).

We confirmed the efficiency and justification of the applied early rehabilitation program for hemiplegics after CVI through monitoring of the parameters crucial for the prognosis of the medical rehabilitation outcome, and those are: the time of the appearance of spasticity and active movements on the plegic extremities, the time needed for establishing the balance in the sitting position and the time needed for establishing the balance in the standing position. The studies have shown that if these parameters are positive, the valuable improvement of the motoric function, with the right medical rehabilitation program, will be achieved in approximately 80 - 90% of cases (3). Therefore, early spasticity and active movements on the plegic extremities, as well as early established balance in the sitting and standing positions represent positive prognostic signs and confirm the adequacy and efficiency of the applied medical rehabilitation program (3).

The application of the early rehabilitation program after the CVI significantly shortens duration of hospitalization for about eight days. The shorter hospitalization time could result with lower treatment costs, which is a significant economic aspect of the early rehabilitation program for the patients after the CVI. The importance
of the physical and rehabilitation treatment of hemiplegic
patients after the CVI is often discussed issue. Back in
1977, monitoring of CVI patients through 19 studies,
with more than 3000 patients, showed that specialized
institutional treatment provided higher degree of func-
tional ability than other forms of treatments, such as
home treatment, or only neurological treatment. After
the institutional physical and rehabilitation treatment,
there were 7,1% less patients who had to be additionally
institutionalized (homes for disabled persons care), 6,4%
less patients who required someone’s help with the every
day life activities and the mortality rate was reduced by
4,5% (13). The reasons for the positive effects of the
institutional physical and rehabilitation treatment are
based on the early introduction of the rehabilitation and
physiatric procedures into the treatment program for the
patients after the CVI (2).
Numerous contemporary studies essentially changed the
attitudes in regard to the significance of application of
these procedures. Many of these studies show that pa-
tients’ functional recovery after the CVI does not depend
primary on the actual method of the kinesitherapy, but
rather on the time that physical and rehabilitation treat-
ment are initiated after the CVI. A study compared the
effects of the Bobath method and the method based on
the movement in two groups of patients after the CVI
(14). Using many outcomes measure it was concluded that
there was no statistically significant difference in the
functional recovery between two groups of patients
treated with different rehabilitation programs, when
these programs were implemented in comparable time
frames.
Most of the authors emphasize the significance of the
early start of the medical rehabilitation after the CVI,
at the so called “Stroke unit”. Only timely initiated and
daily implemented medical rehabilitation can lead to
the early and more complete functional recovery and
psychosocial re-education of the patients after the CVI.
Adequate and timely applied rehabilitation after the CVI
positively impact the quality of life of these patients.
(15).
Prior to our study, the early physical and rehabilitation
treatment of the patients after the CVI were not conduct-
ed in the Clinical Center Kragujevac. The present system
of care for stroke patients does not meet the needs and is
not in accordance with the modern trends in Europe
and elsewhere in the world. Thus, there is a real need of
the system restructuring. One of the options might be
the development and implementation of the National
project of stroke prevention and treatment, on the model
of other transitional countries in Europe that have faced
similar problems and epidemiological parameters. The
following strategic points should be set for the project:
a) analysis of stroke epidemiology in Serbia, with due
reference to regional variation (population-based studies,
hospital-based studies, hospital stroke registries, etc.),
b) reducing the incidence of stroke through improved
primary and secondary prevention and c) reducing stroke
lethality, disability and mortality through establishment
of stroke units and improving the system of patient
rehabilitation. In the interim, the current principles of
diagnosis, management and prevention of stroke, ac-
cepted in the USA and West European countries, should
be followed, and favorable experience of the leading
Serbian neurologists and physiatrists engaged in the field
should be used. In addition, the Guidelines for stroke
prevention and treatment, issued by the Serbian Society
for neurovascular disorders, are of great help to the clini-
cians (16). Thanks to this research, we introduced the
implementation of the early rehabilitation program for
the patients in the acute phase after the CVI in the Cer-
ebrovascular disease unit. The achieved results shortened
the duration of hospitalization in the Center for Neuro-
logy for these patients. Thanks to the implementation
of the early rehabilitation program these patients were
well-prepared for continuation of rehabilitation at the
Center for Physical Medicine and Rehabilitation, which
produced better results of the secondary rehabilitation
and more successful recovery of these patients.
In conclusion, our results suggest that implementation
of the early rehabilitation program for the hemiplegic
patients after the CVI favorably impacts the course and
the final outcome of the treatment, and prevents the skin,
cardiovascular, respiratory, locomotive and urinary sys-
tem complications or alleviates their consequences and
positively impact the quality of life of these patients.

REFERENCES
1. Feigin VL, Lawes CMM, Bennett DA, et al. Stroke epidemiol-
ology: a review of population-based studies of incidence, prevalence,
and case-fatality in the late 20th century. Lancet Neurol 2003;
2: 43-53.
faculty, 2001. (in Serbian)
5. Adams HP, Adams RJ, Brott T, et al. Stroke Council of the Ameri-
can Stroke Association. Guidelines for the early management of
patients with ischemic stroke: A scientific statement from the
36: 916-23.
6. Jovic S. Kinesitherapy for injuries and central nervous system
8: 21-4. (in Serbian).
352: 1677-84.
of wrist and fingers for sensory and functional recovery in acute
11. Clinical Center Kragujevac. The protocol for treatment of acute
in Sep 2006 at www.kbc-kg.co.yu).
rehabilitation and neurodegenerative disorders. VI. Movement