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Original article

Feasibility of a self-rehabilitation program for the upper limb for stroke patients in Benin

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ABSTRACT

Introduction: Stroke is a major cause of disability and represents a very high cost in developing countries. Self-rehabilitation programs represent a new and original treatment for stroke patients, likely to reduce upper limb impairments and improve activity and participation. The goal of this study is to evaluate the feasibility of a self-rehabilitation protocol in Benin.
Methods: Twelve chronic stroke patients carried out the upper limb self-rehabilitation program (3 hours/day, 5 days/week for 2 weeks). The performance of these patients was evaluated before and after the self-rehabilitation program, by measuring the number of exercises that patients were able to achieve during a three-hour session, and by assessing their gross manual dexterity.
Results: Twelve patients were effectively able to complete the entire program. The number of unimanual exercises and self-mobilizations performed during a three-hour session as well as the score of the Box and Block test were improved by the self-rehabilitation program ($P < 0.05$).
Discussion and conclusion: Self-rehabilitation programs are feasible and inexpensive as they do not involve a therapist. It is then a promising approach in stroke rehabilitation, particularly in developing countries, where rehabilitation costs are usually supported by patients.

1. Introduction

Stroke is a major cause of morbidity and mortality, in developed and developing countries alike [1,2]. It leads to major financial burden in terms of healthcare costs for the acute and chronic management of the pathology [3]. In developing countries, the socio-economic environment remains a limiting factor in the healthcare system support [4,5]. The number of existing rehabilitation structures is limited, and costs of this rehabilitation care are most often supported by patients themselves [6,7]. Very few patients are financially able to benefit from this rehabilitation care. Alternative rehabilitation methods are thus necessary to answer growing rehabilitation needs [8] in developing countries.

Community-based rehabilitation (CBR) was initiated by the World Health Organization (WHO) in 1978. It has been defined as "a strategy to improve the access to rehabilitation care for disabled persons in low-income countries, by optimizing the use of local resources" [9]. Its main objective is to ensure that "disabled persons can develop to the maximum their physical and mental capacities, in order to achieve a full social integration in their community and society" [10]. Among CBR programs, self-rehabilitation programs [11,12] are part of the "ability for a person to manage his or her symptoms, treatment, physical and psychosocial consequences of his or her disease" [13]. They can be administered individually, or in groups, at the hospital or the patient's home, or in a community hall [14]. They could help increase the number of rehabilitation sessions for patients without further implication from professional rehabilitation therapists [15].

In developing countries and especially Benin, patients benefit from very few rehabilitation sessions due to the absence of a social security system, high cost of sessions, as well as the limited number of professionals and rehabilitation structures.

In Benin, CBR structures, directed by community agents who did not receive specific rehabilitation training, provide rehabilitation services and support for community re-insertion for patients with various disabilities. These structures may be used in this context to guide the self-rehabilitation of patients with post-stroke hemiparesis.

To our knowledge, no study has specifically evaluated self-rehabilitation programs in developing countries. Our objective was

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to demonstrate the feasibility of an upper limb self-rehabilitation program in chronic stroke patients in a developing country, like Benin.

2. Method

2.1. Patients

Twelve patients were recruited in the Physical Medicine and Rehabilitation (PM&R) department of the National University Hospital of Cotonou, Benin.

They met the following inclusion criteria: time since stroke > 6 months, presence of motor impairments on one side after stroke, obtaining a score of at least 5 out of 7 on the items "toilet transfer" and "locomotion" of the Functional Independence Measure (FIM) scale [16], obtaining a score of 2 or 3 for the distal and proximal motor function of the paretic upper limb on the Stroke Impairment Assessment Set (SIAS) [17], living in their home in the city of Cotonou or its suburbs, having given their written consent for participating in the study. Patients were excluded if they had a Mini Mental Scale Evaluation score below 20 [18], and if they benefited from rehabilitation care in the past two months prior to inclusion.

The study was approved and authorized by the management of the National University Hospital of Cotonou.

2.2. Self-rehabilitation protocol

The self-rehabilitation protocol was described in a guide handed out to the patients. This guide included an introduction explaining the relevance of the self-rehabilitation program, a list of the necessary material and the description of the self-rehabilitation protocol.

The self-rehabilitation protocol was described in common French, it required easily-available material and included three groups of exercises. Its duration: 3 hours.

The first part included passive self-mobilization exercises with the healthy upper limb or active self-mobilizations when possible (exercises A), for 15 minutes. Its objective was to mobilize the paretic upper limb to improve and promote passive joint motion of the shoulder, wrist and paretic fingers.

The second part (exercises B) included unimanual functional exercises performed with the paretic upper limb for 90 minutes. The exercises consisted of bringing a glass to the mouth, stacking up 10 plastic cups, grabbing water-filled bottles, moving cutlery around, moving coins around on a table, and returning each card in a deck of 52 cards.

A 20-minute rest period was observed after exercises B.

The third part included bimanual functional exercises (exercises C) and lasted 40 minutes. The patient had to fold a napkin, button and unbutton a shirt, grab a water bottle with one hand and open it with the other hand.

The description of each exercise included a picture of a person performing the task, to facilitate the patients' comprehension of the required tasks.

The materials necessary for performing exercises B and C were the following:

- ten forks and tablespoons, twelve paper cups (11 empty ones and one filled with water) and ten 0.5 L water-filled bottles, which the patient needs to grab and move around;
- a comb to groom oneself;
- a deck of 52 cards and ten 50fr CFA coins, to perform fine motor skills exercises;
- a shirt, with at least 5 buttons, and a handkerchief, for bimanual exercises of folding and fine motor dexterity;
- a stop watch or a watch, to monitor the time needed to perform the exercises.

To carry out these exercises, the patient had to sit on a chair facing a table where the material was laid out.

2.3. Study protocol

Along with a family member, patients were invited to attend a session where the self-rehabilitation protocol was explained. A demonstration by a physiotherapy student and a patient was also part of this introductory session. All patients were also handed out the self-rehabilitation protocol as a written document detailing the execution of the exercise and the duration of each exercise.

After this introductory session, patients had a week to collect the necessary material for the exercises. Then, the self-rehabilitation protocol was performed at home, if necessary with the help of the person who came to the introductory session with the patient. Patients were asked to perform the exercises 3 hours per day, 5 days/week for a 2-week period. Patients were advised to do the exercises for 3 hours during each session. They were contacted by phone every two days, in order to enquire about eventual difficulties and to encourage them to continue the treatment. They were also asked to note each day the difficulties encountered in a notebook. Evaluations took place twice. The first one in the two days before the start of the program, and the second one in the two days following the end of the program.

2.4. Assessed variables

The patient had to carry out the entire protocol during the two evaluation sessions. Repeat exercises consisted of the number of times the patient was able to perform each group of exercises during the given time period. The patient's performance was evaluated as the difference between the numbers of repetitions in the two evaluation sessions.

The "Box and Blocks" test was also performed. This test assesses gross manual dexterity. It consists in moving around as many blocks as possible from one compartment to another. Norms are available for adults according to age, sex and upper limb laterality [20].

A 13-item questionnaire (Table 1) was designed and handed out to patients at the end of the rehabilitation program to look for the presence or absence of material, temporal, motivational and family barriers to performing the self-rehabilitation protocol, as well as assessing fatigue and patients' satisfaction in participating in such a program.

2.5. Statistical analysis

A descriptive analysis of patients' characteristics was performed. A paired samples *t*-test was done to compare results pre- and post-treatment. $P \leq 0.05$ was considered significant. Statistics were conducted with Excel 2010 and Sigmastat 3.5.

3. Results

All patients were able to carry out the entire self-rehabilitation program, 3 hours per day, 5 days a week over a 2-week period.

Table 1 presents the feasibility of the exercise program as perceived by patients.

Most patients (8) judged that the duration (3 hours) of the self-rehabilitation protocol was sufficient, and only two patients found the daily program too long (Table 1). All patients found the written protocol guide clear and understandable. They were all able to gather the necessary material and were satisfied with the rehabilitation program. Most patients (83%) presented with

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Table 1
Motivation and dropout factors.

Parameters	*n*
Duration of the protocol	
Insufficient	2
Sufficient	8
Very long	2
Feeling the exercise-related fatigue	
No fatigue	2
Acceptable (not leading to exercise interruption)	10
Unacceptable (leading to exercise interruption)	0
Understanding instructions	
Yes	12
No	0
Dropping-out of the exercises	
Yes	0
No	12
Protocol satisfaction	
Satisfied	12
Dissatisfied	0
Acquiring exercise-related material	
Yes	12
No	0
Obtaining human help	
Yes	4
No	8

acceptable fatigue that did not require stopping the exercises and 66% were not able to find a person to assist them with the program.

Table 2 presents the difference between pre- and post-treatment scores for the variables assessed for each patient.

We note that patients significantly improved their BBT score (26%, $P = 0.007$), the number of self-mobilization exercises (exercise A, 19%, $P = 0.006$), and the number of unimanual exercises (exercise B, 32%, $P = 0.02$). However, differences observed for bimanual exercises (exercise C) were not significant ($P = 0.1$).

4. Discussion

Our objective was to show the feasibility of an upper limb self-rehabilitation program for chronic stroke patients in Benin.

The twelve patients were able to execute the entire program, i.e. 30 hours of exercises in all, which underlines good treatment compliance and the willingness of patients to participate in such a program.

Jurkiewicz et al. [21] reported that fatigue was a factor of poor treatment adherence to home-based exercises. In our study, the duration of the protocol was acceptable and did not lead to significant fatigue for most patients. Harris et al. noted that 28% of their patients had pain from 2 to 8 on the Visual Analog Scale at the beginning of the treatment; the pain disappeared after the third week of treatment. These authors did not find any adverse events in patients following the self-rehabilitation protocol [15].

In the general context of multi-languages in Africa and especially in Benin where the illiteracy rate is around 67% [22], it seemed essential for the text of the self-rehabilitation protocol to be written in a clear and easily comprehensible language for patients or their parents, in the official French language. No comprehension difficulties were noted in this study, which promoted the proper execution of the exercises. It would be relevant in further studies to associate images to the text in order to illustrate the exercises, which would improve the comprehension even more.

The necessary material for the protocol was easily collected by all patients. They are basic things that most people already have in their home, the approximate cost was 6000fr CFA i.e. 10 euros. Nevertheless, it is important to note the difficulty for most patients to find a person to help them set the material and monitor the exercises if necessary. One could question the relevance of developing a self-rehabilitation protocol not requiring the help of a third party to be performed, while keeping in mind that family support is a motivation factor according to Jurkiewicz et al. [21].

This program also led to a global improvement of the paretic upper limb as evidenced by the unimanual exercises and the BBT. However, we did not observe any significant difference for bimanual exercises, which could be related to the short duration of the self-rehabilitation program and the absence of a specific functional scale to evaluate bimanual activities. It is important to note that this is a preliminary study, with a small sample of patients, meaning that one cannot draw any conclusions on the effectiveness of such a program. These results need to be validated on a larger number of patients, for example in the framework of a randomized, controlled trial.

Nevertheless, very few studies have evaluated the efficacy of upper limb self-rehabilitation programs in stroke patients [15]. In a multicenter, randomized, controlled, single-blind study in acute stroke patients, Harris et al. [15] evaluated the effectiveness of an upper limb self-rehabilitation program as an adjuvant to

Table 2
Characteristics and performance of patients during exercises.

Patient	Age (year)	Sex (M/F)	Time since stroke (month)	Hemiparetic side (R/L)	BBT score[a]		Number of repetitions					
							Exercise A[a]		Exercise B[a]		Exercise C	
					Pre-T	Post-T	Pre-T	Post-T	Pre-T	Post-T	Pre-T	Post-T
1	69	M	72	L	21	36	488	617	112	291	31	50
2	77	M	20	L	44	54	620	627	288	461	29	38
3	56	F	39	R	9	8	302	346	155	222	7	9
4	68	M	34	R	57	54	699	803	596	445	93	115
5	43	F	25	L	10	8	205	293	164	174	16	13
6	54	F	14	R	29	34	605	535	299	426	7	10
7	63	M	45	R	50	64	479	574	351	586	54	55
8	71	M	24	R	20	31	416	617	312	294	14	17
9	57	M	49	L	15	16	667	681	202	371	48	29
10	30	F	49	R	26	39	538	729	396	561	95	135
11	42	F	7	R	15	26	672	747	328	385	27	31
12	59	M	10	R	0	3	225	252	84	98	22	20
Mean	57.4		32.3		24.7	31.1	493	568.4	273.9	359.5	36.9	43.5
SD	13.7		19.3		17.5	19.0	173.9	180.9	142.5	149.4	30.3	41.1

R: right; L: left; M: male; F: female.
[a] Significant difference between pre-test and post-treatment assessments.

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conventional rehabilitation. The program included self-mobilization exercises, muscle strengthening and stretching exercises, as well as functional exercises (one hour per day, 6 days a week for 4 weeks during a hospital stay, followed by three months at home). Results showed that patients who benefited from this program improved upper limb function evaluated with the Chedoke Arm and Hand Activity Inventory [15]. In another randomized and controlled rehabilitation study in a community hall with chronic stroke patients, Pang et al. [8] also found an improvement of the Wolf Motor Function test score in treated patients.

For other authors, these programs could help keep patients in their home environment, which would avoid difficulties linked to a new integration after a hospital stay [23]. Another important benefit of these self-rehabilitation programs is the decreased healthcare costs as underlined by Teng et al. in a Canadian study [24], similar to Foster et al. [25]. Self-rehabilitation would improve the patients' psychological status, but also their overall health status [25].

Our study showed that the self-rehabilitation program is feasible at home and could become an important part in the rehabilitation care management post-stroke in developing countries.

Study limits are: the small number of patients, study design, short duration of the self-rehabilitation program and absence of a specific functional scale assessing bimanual activities (such as the modified Frenchay scale). These encouraging results must be validated by a randomized, controlled, single-blinded study in a larger population. Our team will shortly conduct a study of this type in Benin. The study will focus on 56 adults with hemiparesis following a stroke (time since stroke $>$ 6 months). Patients from the experimental group will benefit from an 8-week self-rehabilitation program in addition to their usual treatment. Patients from the control group will not receive additional treatment. The evaluation will take into account the three domains of the International Classification of Functioning, Disability and Health [26], by measuring:

- impairments (Fugl-Meyer Upper Extremity and "Box and Blocks" test);
- activity limitations (ACTIVLIM-stroke, ABILHAND, Wolf Motor Function test);
- participation restriction (WHOQOL-Bref).

5. Conclusion

The results of this preliminary study are encouraging and show the relevance of a self-rehabilitation program in the therapeutic array of stroke patients. This program could be a necessary addition to conventional rehabilitation care management, thus increasing the number of rehabilitation sessions, improving functional recovery and reducing healthcare costs.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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