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## Impact of a program of induced stress therapy on the motor and functional recovery of the upper limb of hemiplegic patients in Kinshasa, Democratic Republic of Congo

Demokratik Kongo Cumhuriyeti, Kinshasa'da endüklenmiş stres terapisi programının hemiplejik hastaların üst ekstremitesinin fonksiyonel ve motor olarak iyileşmesi üzerindeki etkisi

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### Abstract

**Aim:** Stroke is a major cause of disability. As a result of rehabilitation, 80% of hemiplegic patients recover in particular, whereas only 28% to 57% recover the grip. Aim of this study is to evaluate the effects of induced stress therapy on motor and functional recovery of the hemiplegic upper limb, to compare the pace of recovery and upper limb autonomy between hemiplegics subjected to induced stress therapy and not subject to induced stress therapy and evaluate the impact of this therapy in the prevention of upper limb neuromuscular complications and disorders.

**Methods:** This is an interventional study conducted in 30 hemiplegic vascular patients followed at the University Clinics of Kinshasa and at the General Reference Hospital of Kinshasa for 6 months. The pace of recovery was evaluated by the motor index of Demeurisse. We used Pearson's chi - square to compare the results. The significance level was considered for the value of  $p \leq 0.05$ .

**Results:** The mean age of these patients was  $57.5 \pm 10.5$  years, with a male predominance (63.3%). The majority of these patients were civil servants (23.3%), traders (16.7%) and teachers (16.7%), trades making frequent use of the upper limb. After 6 months of re-education, there was no significant increase in tone in patients undergoing stress-induced therapy ( $p=0.34$ ), whereas, for the comparison group, the increase in tone was very significant ( $p=0.01$ ); a very significant improvement in motor function ( $p=0.000$ ) was observed for the group of induced stress therapy, and significant ( $p=0.05$ ) for the comparison group. The progression of pain was good for the group of induced stress therapy ( $p=0.02$ ), and negative for patients not subjected to induced stress therapy ( $p=0.5$ ).

**Conclusion:** In the course of this study, it was found that induced stress therapy is effective in the functional recovery and prevention of neuro-motor disorders of the upper limb of the vascular hemiplegic.

**Keywords:** Stroke, Hemiplegia, Upper limb, Induced stress therapy

### Öz

**Amaç:** İnme, önemli bir sakatlık sebebidir. Rehabilitasyonun bir sonucu olarak, hemiplejik hastaların %80'i özellikle iyileşmektedir, oysa sadece %28 ila %57'lik oranlarda kavrama iyileşmektedir. Bu çalışmanın amacı: indüklenmiş stres tedavisinin hemiplejik üst ekstremitenin motor ve fonksiyonel geri kazanım üzerindeki etkilerini değerlendirmek, indüklenmiş stres terapisine tabi tutulan hemiplejiler arasında iyileşme hızını ve üst ekstremiten otonomisini karşılaştırmak ve stres terapisine maruz kalmamak ve üst ekstremiten nöromusküler komplikasyonların ve bozuklukların önlenmesinde bu tedavinin etkisini değerlendirmektir.

**Yöntemler:** Bu, Kinshasa Üniversitesi Kliniklerinde ve 6 ay boyunca Kinshasa Genel Referans Hastanesi'nde takip edilen 30 hemiplejik vasküler hastada yapılan girişimsel bir çalışmadır. İyileşme hızı Demeurisse motor indeksi ile değerlendirildi. Sonuçları karşılaştırmak için Pearson'un ki - kare değerini kullandık. Anlamlılık düzeyi  $p \leq 0,05$  değeri için kabul edildi.

**Bulgular:** Olguların yaş ortalaması  $57,5 \pm 10,5$  yıldır ve erkek ağırlığı %63,3 idi. Bu hastaların çoğunluğu memur (%23,3), tüccar (%16,7) ve öğretmen (%16,7), üst ekstremiten sık kullanan esnaflardır. 6 aylık yeniden eğitimden sonra, strese bağlı tedavi uygulanan hastalarda tonda belirgin bir artış görülmezken ( $p=0,34$ ), karşılaştırma grubunda tonus artışı çok anlamlıydı ( $p=0,01$ ); indüklenmiş stres tedavisi grubunda motor fonksiyonda çok önemli bir iyileşme ( $p=0,001$ ) ve karşılaştırma grubu için anlamlı ( $p=0,05$ ) bir artış gözlemlendi. Ağrının ilerlemesi, indüklenmiş stres tedavisi grubuna ( $p=0,02$ ) ve indüklenmiş stres tedavisine maruz kalmayan hastalar için negatif idi ( $p=0,5$ ).

**Sonuç:** Bu çalışmanın sonucunda, vasküler hemiplejik üst ekstremiten nöro-motor bozuklukların fonksiyonel iyileşmesinde ve önlenmesinde indüklenmiş stres tedavisinin etkili olduğu bulunmuştur.

**Anahtar kelimeler:** İnme, Hemipleji, Üst ekstremiten, İndüklenmiş stres tedavisi

## Introduction

Stroke is a major cause of disability and the third leading cause of death after myocardial infarction and cancer in the West [1,2]. The disability related to hemiplegia partially or totally depends on the patient in performing activities of daily life post-stroke. Yesterday apparently absent from sub-Saharan Africa [3], cardiovascular diseases including stroke are now emerging and constitute a major public health problem [4,5]. In the Democratic Republic of Congo (DRC) hospital admissions for stroke occupy the first place among the conditions treated in internal medicine in Kinshasa [6]. Stroke is an acute condition that requires emergency treatment and chronic disease that leads to disabling sequelae requiring long-term management [7]. Numerous studies have shown the effectiveness of rehabilitation in both acute and chronic phase. There are several methods (Perfetti, Bobath ...) used for the rehabilitation of hemiplegic patients, but no study has demonstrated their effectiveness [8], and the results obtained are not always satisfactory

Thus, following a reeducation, there is in particular greater difficulty in obtaining a recovery of the function of the upper limb relative to the lower limb. While 80% of hemiplegic patients recover walking, only 28% to 57% recover the grip [9].

Neuromotor disorders of the upper limb after a stroke make it difficult to perform the various tasks, such as extending the bottom, grabbing and manipulating an object. This situation disrupts the daily activities of life, such as showering, dressing, eating, or bathing.

In order to improve the management of the upper limb of the vascular hemiplegic, new techniques have emerged in recent years, such as mirror therapy, mental imagery, induced stress therapy, etc. [10].

The latter approach is beginning to be integrated more and more in the treatment of hemiplegics followed in the rehabilitation services of the city of Kinshasa province, in the Democratic Republic of Congo. However, we did not find any scientific studies proving its effectiveness; hence the motivation of this study.

## Materials and methods

### Framework and period of study

The University Clinics of Kinshasa (CUK) and the Kinshasa Provincial Reference General Hospital (HGPRK) were chosen as study framework during the period from 01 August 2017 to 01 January 2018. This choice was justified by the high frequency of admission of patients for cerebrovascular accident.

### Study population

It is made of vascular hemiplegic patients outside the acute phase and admitted to rehabilitation. The selected patients met the following criteria: Patients who have agreed to participate in the program, Not having started re-education sessions elsewhere (for the experimental group), Who did 3 months of rehabilitation (for the comparison group), Patient with a motor score of Demeurisse <40 and a modified Ashworth  $\leq 2$  on the upper limb. Also included were the records of patients undergoing rehabilitation, who formed the comparator group. Anyone who did not meet the above criteria was excluded.

### Type of study

This is an experimental study that has demonstrated the effectiveness of stress therapy induced in the rehabilitation of the upper limb of hemiplegic patients in post stroke.

The clinical results obtained with induced stress therapy (IDT) were compared to those of patients rehabilitated by other methods commonly used in our environment.

### Method of data collection

Data was collected from patients and medical records using a pre-established form. For TCI patients, clinical evaluations at the beginning and end of the program were conducted. These evaluations concerned the pain assessment (EVA), the spasticity and the motor level of the patients. In patients in the comparison group, we collected clinical data at 3 months of rehabilitation. In medical files, we collected information related to socio-demographic, diagnostic and therapeutic aspects.

### Study variables

- Sociodemographic variables: Age (in years), Sex (male or female), Occupation / occupation
- Clinical variables: Duration of hospitalization (in days), Type of stroke (ischemic or hemorrhagic), Spasticity by the modified Ashworth scale, Presence of pain (EVA), Motor level (by the Demeurisse motor index)

### Sampling

We took a convenience sample based on the patients available for rehab. We had received a total of 38 patients and, after selection, we selected 30 patients who constituted our sample, including 15 for the group followed by TCI and 15 others who had followed another program.

### Operational Definitions

**Demeurisse Motor Index:** This is a validated motor assessment scale specifically developed for the evaluation of vascular hemiplegics. It stems from muscle testing. This is a simple, validated and recommended evaluation for hemiplegic patients. This scale refers to shoulder abduction, elbow flexion, thumb-index end-to-end grip, hip flexion, knee extension, and dorsiflexion of the foot. The evaluation gives a motor score of 100 for the upper limb and 100 for the lower limb; we divide each of these scores by 2 and we obtain an overall score out of 100. For our series, we only considered the score of the upper limb side to 100 and assigned the following scores:

- From 0 to 9: no motor activity;
- From 10 to 39: low motor activity;
- From 40 to 59: Average motor activity;
- From 60 to 79: acceptable motor activity
- From 80 to 100: good motor activity

**Modified Ashworth scale:** it is a non-linear but validated and reproducible scale evaluating the resistance of a muscle (spasticity) during its passive elongation (passive movement).

It goes from 0 to 4:

0: no increase in muscle tone

1: a discreet increase in tone manifested by a jump followed by a relaxation or by a minimal resistance at the end of the movement.

1+: a discreet increase in muscle tone manifested by a jump followed by a minimal resistance perceived on less than half of the range of motion.

2: more marked increase in muscle tone affecting most of the range of motion. The joint can be mobilized easily.

3: a significant increase in muscle tone making passive mobilization difficult.

4: the affected joint is fixed in flexion or extension (abduction or adduction)

EVA: Visual analogue scale, it gives an estimate of the intensity (quantification) of the pain ranging from the absence of pain (zero) to the intense pain (ten), a scale ranging from 0 to 10.

Good evolution

Was considered to have a good evolution, the patient of which:

- The modified Ashworth scale was rated less than or equal to 1

- EVA less than 3

- Demeurisse motor index greater than or equal to 60.

Course of the program

Induced stress therapy is one of the new approaches to the rehabilitation of the upper limb of the hemiplegic patient.

It consists in blocking the healthy limb of the patient to force him to use his sick member. Its effectiveness, largely based on the fight against the phenomenon of "non-use acquired", is highlighted in many studies.

After a therapeutic education that consisted in explaining to the patient what induced stress therapy was, we started the program.

Evaluation

We conducted two evaluations during our program. The first at the beginning, the second at the end of the program. These two evaluations consisted of examining the patient in a general way, but more particularly the following aspects:

- Tone appearance using the modified Ashworth scale to highlight the presence or absence of spasticity.

- Pain aspect, consisted of evaluating the intensity of the pain in these patients.

- Motor aspect consisted in evaluating the motor level of the upper limb of the patient, using the motor index of Demeurisse.

Treatment proper

The principles of treatment consisted of:

- Respect the fatigability of the patient
- Fight against spasticity and avoid strengthening it
- Fight against syncinesies
- Adapt the exercises to the patient's abilities
- Allow the patient to do his activities of daily living (ADL) within his capacity.

- The healthy limb being immobilized by an immobilization vest, an immobilization scarf or a velpo band, and the patient had to perform the different tasks or activities of daily life with the sick member. Different objects and toys were used to perform various tasks such as showering, combing hair, eating, writing, moving an object, etc. We also used other exercises involving the cognitive abilities of the patient (concentration, memorization, intention of movement), using different objects (hoops, pads, rings ...) and their characteristics

(shape, size, color, weight ... ), and adapting the instruction to obtain a movement allowing the stretching of the spastic muscle. For example, we use 3 studs and 3 hoops of different colors. We ask the patient to place a colored pad in the hoop of the same color, which is arranged in such a way that it prompts the patient to spread and stretch his arm to stretch his large pectoral and biceps. The first step is to perform the movement with open eyes, then memorize the location of the different hoops to place each cone in the corresponding hoop with closed eyes.

Statistical analysis

The data was entered by Excel, exported and analyzed with SPSS software version 15.0 for Windows. We used Pearson's chi - square to compare the results. The materiality threshold was considered for the value of  $p \leq 0.05$ . Quantitative variables were presented as mean and standard deviation and qualitative variables as proportion and absolute value. The results were presented in the form of tables and figures.

### Results

The average age of these patients is  $57.5 \pm 10.5$  years, with extremes of 19 years and 83 years, and a higher frequency between 55 years and 60 years (Figure 1).

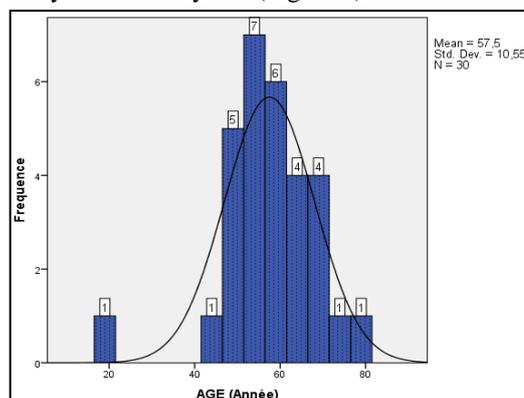


Figure 1: Age distribution of patients

Table 1 shows a male predominance (63.3%) for both the experience group and the comparator group.

Table 1: Distribution of patients by sex

Sex	Group of study				Total	
	Experience group		Comparison group		N	%
Male	10	33,3	9	30,0	19	63,3
Female	5	16,7	6	20,0	11	26,7
Total	15	50	15	50	30	100

In figure 2, it appears that the majority of these patients are civil servants (23.3%), followed by traders (16.7%) and teachers (16.7%).

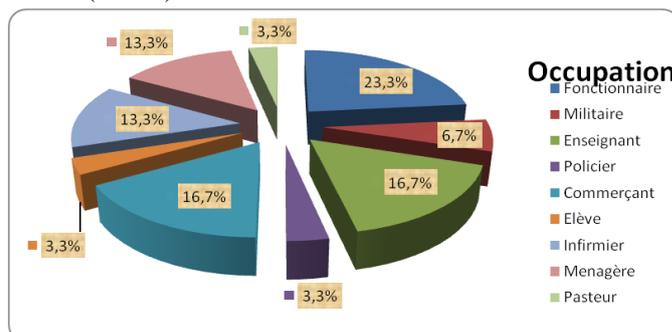


Figure 2: Distribution of patients from two groups according to their occupational occupation

Table 2 gives information on the evolution of spasticity evaluated after 6 months of reeducation by induced stress; it

appears that in this group there was no increase in tone in these patients.

Table 2: Evolution of spasticity level at the end of the program for TCI patients

Level of spasticity (ashworth modified)	Evaluation period			
	Start program		End program	
	N	%	N	%
No spastic hypertonia	8	53,3	8	53,3
Midle hypertonia	5	33,3	7	46,7
Moderate hypertonia	2	13,3	0	0
Total	15	100	15	100

For this group of patients, an increase in tone is observed; patients who had moderate hypertonia at the beginning of the program (33.3%) increased to 66.7% after 6 months, with a significant difference (p=0.01) (Table 3).

Table 3: Evolution of spasticity level at the end of the program for patients not subject to IDD

Level of spasticity (ashworth modified)	Evaluation period			
	Start program		End program	
	N	%	N	%
No spastic hypertonia	7	46,7	0	0
Midle hypertonia	3	20	5	33,3
Moderate hypertonia	5	33,3	10	66,7
Total	15	100	15	100

Evolution of the level of motor skills

Table 4 shows a very significant improvement in the level of motor skills for this group (p=0.000); patients with low motor skills (73.4%) increased to 0% after 6 months of TCI, those with an acceptable level are 0% of patients at 20%.

Table 4: Evolution of motor skills after six months of TCI

Niveau de motricite (index moteur de deumerisse)	Evaluation period			
	Start program		End program	
	N	%	N	%
No motor skills	2	13,3	0	0
Low level of motor skills	11	73,4	0	0
Average level of motor skills	2	13,3	10	66,7
Acceptable level of motor skills	0	0	3	20
Good level of motor skills	0	0	2	13,3
Total	15	100	15	100

Table 5 shows that patients in this group had either low motor skills (46.7%) or moderate motor activity (46.7%); a significant difference (p=0.05) was observed for this parameter, between the initial level and that after 6 months.

Table 5: Evolution of the level of motor skills after 6 months of rehabilitation by other techniques

Level of motricity (deumerisse motor index)	Evaluation period			
	Start program		End program	
	N	%	N	%
No motor skills	4	26,7	0	0
Low level of motor skills	11	73,3	7	46,7
Acceptable level of motor skills	0	0	7	46,7
Good level of motor skills	0	0	1	6,6
Total	15	100	15	100

Evolution of pain

Table 6 shows a good evolution of the pain (p=0.02), the patients who had no pain at the beginning went from 46.6% to 80% after 6 months of TCI, those with Early moderate pain (40%) dropped to 0% by the end of the program.

Table 6: Evolution of pain after 6 months of TCI

Intensity of pain	Evaluation period			
	Start program		End program	
	N	%	N	%
No pain	7	46,6	12	80
Light pain	1	6,7	3	20
Moderate pain	6	40	0	0
Intense pain	1	6,7	0	0
Total	15	100	15	100

Table 7 shows a negative evolution of the intensity of the pain in the patients of this group but with a non-significant difference (p=0.5); those who had not had any pain at first (40%) dropped to 26.7% after 6 months.

Table 7: Evolution of pain after 6 months of rehabilitation by other techniques

Intensity of pain	Evaluation period			
	Start program		End program	
	N	%	N	%
No pain	6	40	4	26,7
Light pain	3	20	5	33,3
Moderate pain	5	33,3	6	40
Intense pain	1	6,7	0	0
Total	15	100	15	100

Discussion

This study was devoted to the evaluation of the effects of stress therapy induced in the rehabilitation of the hemiplegic upper limb. We selected 30 patients among whom 15 were treated by induced stress and the other 15 by other techniques of rehabilitation.

Our sample had a total of 63.3% men versus 36.7% women, with an average age of 57.5±10.5 years, with 19-year and 83-year higher between 55 and 60 years.

In the Daviet et al. study [11], the mean age of the patients was 72 years and corresponded to the age usually reported in the other studies in Europe which is 72 years for the London registry and 74 years for the register of Dijon. This difference with our series can be explained by the fact that the European population is older than ours.

In addition, according to some epidemiological studies, intracerebral hemorrhage occurs mainly after age 50 and concerns more men [12]. This goes in the direction of our series.

The majority of these patients were civil servants (23.3%), followed by traders (16.7%) and teachers (16.7%).

It is then found that in carrying out the aforementioned professional activities, the use of the upper limb is essential, especially to hold the pen and chalk. Hence the need for a good evaluation that will lead to better management, especially involving therapy that does not often require inadvertent manipulation of the hemiplegic upper limb which is in most cases fragile.

From the muscular tonus point of view, we found that the two groups were homogeneous at the beginning of the program, there was no significant difference between them (p=0.3). In addition, most of these patients (53.4% for the TCI group, 56.7% for the comparison group) did not have spasticity at the beginning of the program.

There is no significant difference (p=0.7) between the two groups in relation to the intensity of the pain; most patients had no pain (46% of the cases for the TCI group versus 40% of the cases for the comparison group), followed by those with moderate pain (40% for the TCI group against 33, 3% of cases for the comparison group).

The majority of these patients had a low level of motor skills (73.4% of cases for each group) at the beginning of the program; and there was no significant difference between the two groups with respect to the Deumerisse motor index (p=0.2).

In evaluating the rehabilitation techniques used in the treatment of patients in the comparison group, massage proved to be the most used technique (86.7%), followed by Bobath and Kabath techniques (66.7%) and infrared thermotherapy (66.7%).

In a study conducted at University Clinics in Kinshasa, mobilizations (76%), massage (60%), Bobath technique (60%) and Kabat technique (52%) were reported to be the most commonly used. rehabilitation of patients in post stroke (13); and

those electro-physiotherapy techniques were more dominated by infrared irradiation (28%).

Moreover, it is currently reported that re-education gives back its place to the asset; Robertson and Regnaud [13] synthesized the main studies validating the principles of motor learning insisting on active patient participation, the need for repeated gestures, in an intense and task-oriented way.

Regarding the assessment of the evolution of spasticity in our patients, made by the modified Ashworth scale, we found that after 6 months of stress-induced rehabilitation there was no significant increase ( $p=0.34$ ) in patients with TCI. Patients who did not present hypertonia at the beginning of the program (53.3%) kept their level until the end (53.3%), slight hypertonia went from 33.3% of patients to 46.3% of patients, 7% and moderate hypertonia from 13.3% to 0% of patients.

On the other hand, for the group of non-TCI patients, an increase in tone is observed; patients who had moderate hypertonia at baseline (33.3%) increased to 66.7% after six months, with a significant difference ( $p=0.01$ ).

Around the world, approximately 2,000 individuals per million are affected each year by stroke. Of these, just under 40% continue to have spasticity a year later [14]. This percentage of 66.7% of patients with spasticity in our series after 6 months of rehabilitation is high and may be due to an inappropriate treatment that favors manual manipulation (which increases the stretch reflex) to more active rehabilitation.

In another study it was reported that post-stroke spasticity affected just under a quarter of patients. Thus techniques that can increase the stretch reflex should be avoided because spasticity can have a devastating effect on function, comfort, delivery of care; it can lead to musculoskeletal complications, leading in most cases to a reduction in the extent of movement and poor positioning, often accompanied by pain [15].

In relation to motor skills, a very significant improvement ( $p=0.000$ ) was observed for the group of patients submitted to TCI at the end of the program; patients with a low level of motor skills (73.4%) increased to 0% after 6 months of TCI, those who had an acceptable level went from 0% of patients to 20%.

In the comparison group, patients were found to have either a low motor level (73.3%) or a nil motor activity (26.7%); In addition, patients who had either an average level (46.7%) or a good level of motor skills (6.6%) all switched to the lower level, with a significant regression ( $p=0.05$ ).

This good motor development observed after induced stress finds its justification in the sense that by its intensive nature, it significantly improves the quality and speed of movement in patients who practice it. These findings have been demonstrated in the Wolf et al randomized EXCITE study published in 2006 [16].

With regard to the evolution of pain, a good evolution of pain is observed ( $p=0.02$ ); patients who had no initial pain went from 46.6% to 80% after 6 months of TCI, those with moderate early pain (40%) increased to 0% at the end of the program.

On the other hand, there was a negative change in the intensity of pain in non-TCI patients, but with no significant

difference ( $p=0.5$ ); those who had no initial pain (40%) tipped to 26.7% after 6 months and those who had moderate early pain (33.3%) increased to 40% after treatment.

Indeed, some unconstrained reeducations obtain very satisfactory results but seem less effective in time compared to those who practice the constraint [17].

#### Conclusion

TCI has been found to have not only positive effects in the functional recovery of the upper hemiplegic limb, but also in the reduction of certain disorders that may follow the improper handling of other rehabilitation techniques.

It is therefore necessary that the induced stress therapy is introduced in the protocol for the management of vascular hemiplegia because its effects are beneficial.

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