STROKE IMPACT ON THE COGNITIVE FUNCTIONS OF MOROCCAN NEURO-LESIONED PATIENTS IN THE GHARB REGION

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SUMMARY

Stroke (ischemic and hemorrhagic stroke) is a sudden-onset neurological deficit resulting from focal vascular lesions. This is due to a clot-induced obstruction of a vessel (ischemic stroke) or a rupture of a vessel causing haemorrhage (hemorrhagic stroke). The management of neuro-injured patients (AVC) is a major public health problem. The principal aim of this study is to evaluate the short and long term neuropsychological sequences following a neurological accident of neuro-injured patients hospitalized at the Kenitra Provincial Center (Morocco) in comparison with the control group.

We tested 34 stroke patients, with an average age sample of 59.12 years, for a standard deviation of 14.35 with extremes between 32 and 82 years. Of these patients, 20 were female (58.82%) and 14 male (41.18%). The sex ratio is 0.7 in favour of the female sex. Both the neuro-lesioned patients and the control group benefited from neuropsychological tests. In the neurocognitive evaluation we used three neuropsychological tests: (a) The bell test or non-verbal bell dam test allows for a selective, visuospatial and strategic attentional evaluation; (b) Raven’s test focuses on the nonverbal neuropsychological intelligence where the subject is led to analyze and solve each test problem based on inductive reasoning; (c) The digit memory test is a test to evaluate the short-term verbal memory and working memory capabilities of stroke patients.

Our results showed through the various neurocognitive tests that our stroke patients obtained lowers score, compared to the control group (p <0.05). Raven Standard Progress Matrix Test Scores (SPMR): (Mean-Patients = 32.49, SD = 7.43 < Mean-Controls = 42.01, SD = 3.98). Digit Memory Test scores: Forward digit span (Mean-Patients = 2.21, SD = 0.5 < Mean-Controls = 2.65, SD = 0.49). Backward digit span (Mean-Patients = 1.74; SD = 0.6 < Mean-Controls = 2.41, SD = 0.5). Bell test (Mean-Patients = 24.35; SD = 2.62 < Mean-Controls = 30.18; SD = 2.52). The patient quality of life is consequently highly affected.

Rehabilitation was effective and is very important because it improves cognitive functions such as nonverbal skills, visuospatial and strategic attention, along with the digit memory equally improving patient quality of life.

Key words: ischemic and hemorrhagic strokes, brain injury, neurocognitive tests, remediation, Morocco
INTRODUCTION

Stroke is a major public health problem, both in terms of the number of people affected, which is constantly increasing in view of population aging, and through its medical, social and economic consequences (Fery-Lemonnier, 2009). Ischemic and hemorrhagic strokes are, defined as a sudden-onset neurological deficit resulting from focal vascular lesions. These are related to clot obstruction of a vessel (ischemic stroke) or the rupture of a vessel causing haemorrhage (hemorrhagic stroke) (Chastonay, 2009).

In France strokes are two to three times less frequent in women than in men between 55 and 64 years. This difference then decreases to cancel itself out after 85 years of age. Similarly, a study conducted by Berthe et al., in the Ivory Coast showed a clear male predominance for this scourge (Berthe et al., 2002). Thus, more men than women are affected by this type of pathology (Elovic and Kirschblum, 1999; Mènon et al., 2015, Mènon et al., 2016). Vascular strokes, cerebral infarction and cerebral hematomas are part of non-communicable diseases (NCDs), and they alone constitute a major public health problem in industrialized countries, though are also prevalent in developing countries. Thus, this was demonstrated by a study conducted by Cossi et al., 2012 in the city of Cotonou in Benin, where the data from the study shows that the prevalence of stroke in Benin is higher than that obtained in a neighbouring country like Nigeria. It is also higher than those obtained in other developing countries, for example India (Cossi et al., 2012). Romania is also confronted with cerebrovascular accidents. In addition, stroke is a public health priority in Romania; which represents one of the main causes of mortality (Mureşanu, 2017).

Like other countries in the world, Morocco is seriously threatened by cardiovascular diseases which constitute an epidemiological issue. Among these are strokes, something which currently constitutes a real health problem in Morocco, for reasons such as the frequency of vascular risk factors (Plan d’action santé, 2008-2012 cited by Hazzami, 2010; Mènon et al., 2016).

The practical difficulties these people face in their daily lives seem to come from the gross negligence of important information, poor planning and time management, as well as a lack of judgment and spontaneous organizational skills called „executive functions‟ (Burgess and Shallice, 1996). These cognitive impairments and their functional sequel have a devastating impact on people with brain injuries and their families, due to the difficulty of returning to any normal functioning in the activities of daily living and their surveillance and localization requirements. Most often, these cognitive impairments have been defined empirically using performance on neuropsychological tasks, but a theoretical model could suggest which cognitive processes are involved and define ways to measure the deficits, thus offering significant advantages.

In this study, we used neuropsychological tests as a framework to explore the nature of deficits in the executive function in neuro-injured patients; and here we have with two main objectives:
to evaluate the performance in patients following a cerebrovascular incident in the Gharb region, in both the short and long term according to the cognitive severity; by different batteries of neurocognitive tests: Raven’s test, which is based on a non-verbal inductive reasoning by analogy, the numeric span test measures mnemonic verbal abstraction and the bell test or non-verbal bell dam test allows for a strategic visual-spatial assessment.

• to study cognitive remediation methods in stroke patients.

PATIENTS AND METHODS

Patients

Thirty-four stroke patients were recruited. 19 stroke patients were recruited from the Department of Neurosurgery and 15 from the Department of Medicine at the Provincial Center of Kenitra, Morocco and 34 healthy people (the control group) were recruited from the community to participate in the study. The inclusion criteria for stroke patients were as follows: 1) Subjects with a standard deviation of 14.35; the average age being 59.12 years old with extremes between 32 and 82 years; 2) Availability of medical records of brain injuries (CT scan, GCS score on hospitalization, the results of the neurological examination conducted at the time of injury). 3) CT or MRI at admission showing signs of injury including cortical or subcortical contusions, cerebral lacerations, intracranial bleeding (such as meningeal haemorrhage), or hematomas (such as subdural hematomas); Thus, mild to moderately severe and then to severe injuries were recruited; 4) A cognitive assessment was undergone. 5) Able to understand and sign a written consent form).

The Healthy control group (male and female, from 32 years to 82 years old of age) had socio-demographic characteristics that were similar to those of the stroke patients.

The control group consists of patients hospitalized for a pattern of nervous system disorders other than a ischemic and haemorrhagic stroke, and healthy subjects with no clinical signs of a stroke were recruited as controls. Other people were selected from the community health center, and matched by age and gender. The exclusion criteria for the stroke and control groups were as follows: 1) history of significant neurological or psychiatric disorders. 2. alcohol consumption, recreational drugs.

This study took place between April and September 2017 at the neurosurgery and medicine departments of the Provincial Hospital of Kenitra (Morocco) in the Gharb region.

Evaluation tests

Patients and controls benefited from three neuropsychological tests: the Raven (PM38), the Digit Memory Test and the Bell Test.
The bell test is a test for evaluating visual neglect in cerebral adult patients (Gauthier et al., 1989, Azzaoui et al., 2010, Ménon et al., 2015). It is used in this study to measure the visuo-attentional abilities of neuro-injured patients (AVC). In addition, the bell test allows one to distinguish between groups with and without neurological deficits and lesions of the right or left hemisphere. The test consists of presenting the subject with an A4-format sheet containing 112 drawings of objects (saw, apple, horse, car, cloud ...including 35 bells). The patient has to, for 2 minutes, strike out or circle as many bells as possible. At the end of the test, the score (the number of crossed out bells) is noted (Azzaoui et al., 2010, Ménon et al., 2015).

The A4 sheet with the number of bells omitted is subdivided into seven columns, three are on the right side of the page representing the right omission, one is in the middle position indicating the central omission and the three last left which correspond to the left omission. There are four types of omissions highlighted; right omission (RO), left omission (LO), central omission (CO) and total omission (TO) (Ferber and Karnath 2001, Ménon et al., 2015). Therefore, a patient or subject is considered moderately negligent if they are unable to surround the bells in the left-most column. An omission in more the medially located columns will be interpreted as a sign of greater neglect of the left space (Gauthier et al., 1989) (Fig. 1).

**Different strategies**

The strategy used is that of the neuropsychological examination according to the neuropsychological examination of Ahami et al., (cited by Ménon et al., 2015); highlighting the 9 different types of strategies envisaged during the passing of the bell test (A, B, C, D, E, F, G, H and I); which allowed us to identify the correlation envisaged in the 9 types of strategies (A, B, C, D, E, F, G, H and I) of the
bell test vis-à-vis neuro-lesioned patients while being based on laterality, that is to distinguish whether the subject is right-handed or left-handed. **Strategy A:** The subject starts striking out the bells from the top of the A4 sheet, starting from the right towards the left, **Strategy B:** The bell is crossed out from left to right while starting from the top, **Strategy C:** The subject must arrange to start to strike out the bell at the bottom of the A4 sheet while moving from the right to the left side, **Strategy D:** The circling of the bells is done from the bottom of the A4 sheet and from left to right, **Strategy E:** The patient or participant starts to strike out the bell from the right top to the bottom of the A4 sheet, **Strategy F:** The patient starts from the right of the top of the sheet in the format towards the left side, **Strategy G:** This is done from the bottom right to the top of the A4 sheet, **Strategy H:** The subject undertakes the circling of bells from the left direction while starting from the bottom up, **Strategy I:** is the most disorganized; there is no strategy to adopt (Mènon et al., 2015).

Therefore, this description will enable us to find important elements concerning the type of strategy identified at the level of the neuro-injured patient (Mènon et al., 2015).

**Raven Standard Progress Matrix Test (SPMR)**

Raven’s progressive matrices known as PM38 were designed to evaluate intelligence, intellectual ability and general mental skill through the comparison of forms and reasoning by analogy. Raven’s Progressive Matrix Test (1938) was created to evaluate inductive logic reasoning. It consists of 60 problems divided into five series (A, B, C, D and E) of 12 problems, of a complexity order increasing in each, coming in two phases; the first phase comprising the series A, B and C (in 30 minutes) and the second phase comprising the series D and E (in 20 minutes). This test measures the ability of nonverbal reasoning, by analogy; it consists of identifying a transformation in a situation A and transferring it, or in a situation B (Raven et al., 1992; Latifi et al., 2009; Azzaoui et al., 2010; Mènon et al., 2015; Latifi et al, 2017) (Fig. 2).

![Fig. 2. Raven Standard Matrix Samples (Latifi et al., 2009 ; Latifi et al., 2017)](image-url)
Digit Memory Test

This is a subtest (from the Wechsler Adult Intelligence Scale Version (WAIS III): to assess the short-term verbal memory abilities of subjects (Wechsler, 1997). The maximum number of digits that the subject is able to repeat in the order in which they have been said: this is called the forward digit span. When the number of digits that the subject has to repeat is in the reverse order to that which was stated: this is called the backward digit span, which allows an estimation of working memory capacities (Wechsler, 1991, D’Amico and Guarnera, 2005, Deforge et al., 2006, Azzaoui et al., 2010, Mènon et al., 2015) (Tab. 1).

Statistical analysis

The data collected was captured and analyzed using SPSS software (Statistical Package for Social Science). Through using a statistical analysis by the single-factor ANOVA, we could conduct a comparison and deduction across the three tests in the two groups of stroke patients and control group. The materiality threshold is 5%.

RESULTS OF NEUROPSYCHOLOGICAL TESTS

Post morbidity test scores were standardized according to the population mean and standard deviations. The results obtained a corroborate that there are significant differences in the neurocognitive performance of stroke patients when compared to the control group. Statistical analysis of the single-factor ANOVA revealed significant differences between the stroke and control groups (p <0.05): when placing the different test batteries.

<table>
<thead>
<tr>
<th>Figures in direct order Test 1/Answer</th>
<th>Score</th>
<th>Trial 2 / Answer</th>
<th>Score</th>
<th>Total score 0 ; 1 or 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2-9</td>
<td>4-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 3-8-6</td>
<td>6-1-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 3-4-1-7</td>
<td>6-1-5-8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 8-4-2-3-9</td>
<td>5-2-1-8-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 3-8-9-1-7-4</td>
<td>7-9-6-4-8-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 5-1-7-4-2-3-8</td>
<td>9-8-5-2-1-6-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 1-6-4-5-9-7-6-3</td>
<td>2-9-7-6-3-1-5-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 5-3-8-7-1-2-4-6-9</td>
<td>4-2-6-9-1-7-8-3-5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Count in reverse order Test 1 / Answer           score | Trial 2/ Answer | Score | Total score 0 ; 1 or 2 |

| Examples 8-2                                |       |                 |       |                      |
| 1 2-5                                     | 6-3   |                 |       |                      |
| 2 5-7-4                                   | 2-5-9 |                 |       |                      |
| 3 7-2-9-6                                 | 8-4-9-3 |               |       |                      |
| 4 4-1-3-5-7                               | 9-7-8-5-2 |           |       |                      |
| 5 1-6-5-2-9-8                             | 3-6-7-1-9-4 |          |       |                      |
| 6 8-5-9-2-3-4-2                           | 4-5-7-9-2-6-1 |        |       |                      |
| 7 6-9-1-6-3-2-5-8                         | 3-1-7-9-5-4-8-2 |      |       |                      |
Raven Standard Progress Matrix Test Scores (SPMR)

In our 34 stroke patients, there was a significant difference *p* <0.05 in the Raven test scores, with the patient group mean scores (Mean = 32.49, SD = 7.43 less important) compared to the control group (Mean = 42.01, SD = 3.98) (Table 2).

### Digit Memory Test scores

The results of the digit memory test shows that the difference is significant in the forward digit span and Backward digit Span trials in our stroke patients compared to their control group (*p* <0.05).

**Forward digit span**

The forward digits span from the digit memory test showed that the test scores were significantly higher in the control group when compared to stroke patients (Mean-Patients = 2.21, SD = 0.5 <Mean-Controls = 2.65, SD = 0.49 (*p* <0.05) (Table 3).

**Backward digit span**

The results of the figures show that the difference is significant during the passage of the span test in comparison with the control group (*p* <0.05) with an average (Mean-patients = 1.74; SD = 0.6 <Mean-Controls = 2.41, SD = 0.5 (*p* <0.05) (Table 4).

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### Tab. 2. Scores from PM 38 of patients and control group

<table>
<thead>
<tr>
<th>Group</th>
<th>score A</th>
<th>score B</th>
<th>score C</th>
<th>score D</th>
<th>score E</th>
<th>Score total/60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>9.29</td>
<td>7.82</td>
<td>6.41</td>
<td>5.26</td>
<td>3.71</td>
<td>32.49</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.49</td>
<td>1.6</td>
<td>1.5</td>
<td>1.44</td>
<td>1.4</td>
<td>7.43</td>
</tr>
<tr>
<td>Number of patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>Control group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>10.65</td>
<td>9.68</td>
<td>8.35</td>
<td>7.18</td>
<td>6.15</td>
<td>42.01</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.98</td>
<td>0.98</td>
<td>0.69</td>
<td>0.83</td>
<td>0.5</td>
<td>3.98</td>
</tr>
<tr>
<td>Number of patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

---

### Tab. 3. Scores from the digit memory test of patients and control group

<table>
<thead>
<tr>
<th>Group</th>
<th>Forward digit span</th>
<th>Backward digit span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>2.21</td>
<td>1.74</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Total number</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>2.65</td>
<td>2.41</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.49</td>
<td>0.5</td>
</tr>
<tr>
<td>Total number</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>
Bell test

The average number of crossed out or circled bells in our 34 stroke patients was significantly lower (p < 0.05) than in the control group: (Middle- Barred Bells-Patients = 24.35; SD= 2.62 <Medium-Barred Bells-Control group = 30.18; SD = 2.52) (Table 3).

Cognitive remediation

The remediation of a neuro-injured patient is multidisciplinary. The most practiced remediation in our case within the hospital are: Kinesitherapy, speech therapy, ergotheraphy, electrotherapy and InfraRed (IR) before the treatment of muscles. For example other countries such as Romania in the case of stroke patients, we would like to add or recommend other hospital methods of remediation for our Moroccan stroke patients such as electroencephalogram (EEG), EMG (electromyogram) the presence of a psychologist, the practice of psychometry through neuropsychological tests (The Raven test, the test of numbers, the test of bells dams ...) which play a very indispensable role in the treatment of our neuro-injured patients.

The psychological examination may be considered to be an image at a moment in the development phase of the neurocognitive potential and psychic functioning of the subject (Azzaoui et al., 2010). The use of neurocognitive tests in this study aimed to highlight the effect of a stroke on the neurocognitive capacity of stroke patients and to identify the possible neurocognitive deficits that may affect the normal development of the patient and influence their activities, their immediate entourage and thus their future by comparing their performance with that of the control group. The Neurocognitive assessment showed significant differences in the performance of stroke patients when compared to their control group.

Assessment of attention disorders

Thanks to the bell’s test, there is a significant study between our patient and control groups. Our neuro-injured stroke patients are less attentive with a more disorganized crossed-out-bell strategy compared to the control group.

Regarding the bell test; used for selective visual-attention assessment; the significance of scores in our stroke patients (Mean = 24.35, SD = 2.62) was lower compared to the control group (Mean = 30.18, SD = 2.52). Furthermore, accord-
ing to the neuropsychological examination of Ahami et al., (cited by Mènon et al., 2015); revealing the 9 different types of strategies envisaged during the pass-
ing of the bell test (A, B, C, D, E, F, G, H and I); among which strategy I, the most

disorganized has been observed in our neuro-damaged patients compared
(Mènon et al., 2015).

The results envisaged in our patients could be explained by mental exhaus-
tion. Thus, increased mental fatigability during attentional disorders results in a
general decline in cognitive performance affecting all phases of information
processing (Ponsford et al., 1992 and Leclercq et al., 2000 cited by Azouvi et
al., 2010; Mènon et al., 2015; Mènon et al., 2016). Similarly, mental fatigue is
expressed as fatigability during cognitive tasks, irritability, or an increase in the
frequency of headaches (Belmont et al., 2006).

According to the „Coping” hypothesis (adaptation) of Van Zomeren et al.1984,
(cited by Belmont et al., 2006) the mental fatigue of stroke patients would be di-
rectly secondary to cognitive disorders, including attentional disorders: this would
be due to an additional effort consciously or not, by the patient, to compensate
for the slowdown and cognitive disorders in everyday life (Mènon et al., 2015;
Mènon et al., 2016).

**Evaluation of intelligence disorders**

The mean score in series A, B, C, D, and E of the Raven test in the stroke
patients group (Mean = 32.49, SD = 7.43) is significantly lower when compared
to the control group (Mean = 42.01, SD = 3.98).

Several factors may explain the poor performance of IQ with significant dif-
ferences from our stroke patients to the Raven test. These differences could be
explained by abnormal inductive reasoning when solving problems. Thus, some
authors have corroborated that the disturbance of conscious, intentional activity
is frequent following a trauma (Luria, 1973): the patient does not analyze the
data of a problem that is posed to them; it does not establish a general problem
solving scheme or program from the preliminary analysis of this data and is often
limited to giving impulsive answers to certain elements of the data that have
caught their attention and that have been released from the whole; they have
great difficulty passing from one operation to another; Finally, it does not test the
results obtained with the initial data of the problem (Mènon et al., 2015).

**Evaluation of memory disorders**

At the level of the digit memory test, the purpose of which is to test the working
and verbal memory capacity. It consists of two types which are the forward digit
span and backward digit span relates to the work memory.

The study reveals that there is a significant difference in our patients with AVC
during the forward digit span (Mean-Patients AVC = 2.21, SD = 0.5 <Mean-Témoins
= 2.65, SD = 0.49). This difference is very significant during the backward digit
span (Mean-Patients AVC = 1.74, SD = 0.6 <Mean-Témoins = 2.41, SD = 0.5).
The concept of working memory refers to the ability to maintain information in memory while using it and to perform more or less complex cognitive operations. Baddeley (1986, cited by Robin et al., 2008). The results obtained are statistically significant in our neuro-lesioned patients.

These differences could be due to the span at which one starts the test from right to left, from the opposite direction to the normal. In patients, the disorders predominate on the episodic declarative memory and the prospective memory, simplicities memories seem little disturbed. It would be more a deficit of the activation of mnemic processes, perhaps secondary to attentional and dys-executive disorders, than of an attack on stuck memory. Indeed, this is not real forgetfulness to measure but rather a bad learning strategy and retrieval of information, especially in situations of double task, with a misuse of mental imagery and syntactic encoding.

In addition, during the digit memory test, communication disorders were determined during the forward digit span and the backward digit span in neuro-injured stroke patients. Which could be one of the factors that prevents the smooth running of the conversation being the basis of a logorrheic expression with excessive digressions and gossip. Thus, the patient is carried away by a stream of personal comments not adapted to the situation. We sometimes observe perseverations of words or themes, phenomena of palilalies (the involuntary repetition of one or more words) and echolalies (the repetition of the words of the interlocutor) (Mènon et al., 2015).

The memory, intellectual and attentional consequences could disrupt the family, social and professional life of the stroke patient. The Raven test demonstrated significant neurocognitive outcomes among patients during this non-verbal psychological test evaluating intelligence. The same is true of the number test where the results are significant. Thus, these significant differences would confirm that neuro-lesioned patients would present significant difficulties and significant deficits to perform attentional tasks but do not demonstrate the presence of a visuo-perceptive deficit or a planning disorder. The neurocognitive tests used put a special emphasis on the meaning of patients whose impact of the cerebrovascular accident presents an imbalance on health; so they have trouble concentrating at the time of these different test tasks are performed. By inductive reasoning, we can enumerate that these stroke patients would present, certainly, pathological signs during neuropsychological examinations of CT; where the lesions can settle one of the lobes of the skull being the temporal lobe, occipital, parietal, frontal; thus the most contemplated lesions in our patients are frontal.

This deficiency may be due to brain damage by severity (mild, moderate, or severe) based on the most commonly used state-of-consciousness coma depth rating scale that is the GCS scale (or Glasgow Coma Scale) (Mènon et al., 2015).

Indeed, when it is established that a neuro-injured patient is exposed to brain injury at the time of the trauma, the importance of this lesion must be investigated to determine the severity (mild, moderate or severe) since the acute care as well that rehabilitation services will be established according to the severity of the stroke (Cappa et al., 2011; Mènon et al., 2015).
- Mild Neuro-injury: 13 <GCS <15
- Moderate Neuro-injury: 9 <GCS <12
- Serious or severe Neuro-injury: 3 <GCS <8

**Remediation**

The case of remediation of our Moroccan patients have not been the same compared to other countries as the case of Romania where patients are following therapy just after the accident (stroke, stroke or cranial trauma brain, CBT etc).

Cognitive remediation and rehabilitation is a neuropsychological evaluation of patients suffering from mental pathology following intellectual stimulation through various multidisciplinary cognitive remediation programs and assistance with socio-professional reintegration (Deniker, 2017). Cognitive remediation reduces or offsets the impact of cognitive deficits. These can affect neurocognition, metacognition, or social cognition (Yelnik et al., 2008). Rehabilitation improves grip, balance, walking, communication or visuospatial disorders.

The remediation of a neuro-injured patient is multidisciplinary, such as physiotherapy, speech therapy, occupational therapy, EEG (Electroencephalogram), EMG (Electromyogram), psychometrics etc.

Rehabilitation improves grip, balance, walking, communication or visuospatial disorders.

- **Physiotherapist** acts by passive or active rehabilitation on the whole of the motricity, the awakening of this one to its guidance and the control of the abnormal movements. It has a vital role in preventing the complications of spasticity and the acquisition of autonomy.

- **Occupational therapist** contributes to the rehabilitation of the prehension by manual activities, but also to the reeducation of the neuropsychological disorders; they work on home and professional empowerment and rehabilitation.

- **Speech therapist** rehabilitates language disorders and more generally communication, memory disorders, visuospatial disorders, and sometimes swallowing disorders.

- **Psychologist** has the role, one insufficiently developed, to support the patient and their family, or even teams. Specialized in neuropsychology, they help to guide and perform the rehabilitation of disorders of higher functions.

- **Psychometrist or the psychologist**, as in our case, can practice psychometric tests (the Raven test, the test of numbers range, test of bells dams ...). These tests make it possible to diagnose; they also intervene in the therapy of our neuro-lesioned patients, in order to see their current and long-term progress.

- **Psychomotor therapist** can usefully intervene in the care of severely disabled patients.

- **EEG** is a rhythmic activity strongly correlated with particular behaviours: Awakening, attentional levels, cognitive activities, sleep. EEG can intervene in the diagnostic and / or prognosis and / or the therapeutic process.
• EMG allows the muscles to be restored and to wake them up. The purpose of this examination is to analyze the functioning of the peripheral nerves, that is to say the part of the nerves from the spinal cord to the muscle and the skin. It is performed by a neurologist specializing in this technique.

DISCUSSION

Stroke is a threat to the long-term functioning of the brain. With a stroke, brain damage can be very fast, and survival after a stroke is lower than after a heart attack or most cancers (Lees, 2002). “Time is the brain” (Brainin et al., 2007); patients with a suspected stroke should be treated very quickly.

Morocco, like most developing countries, is seeing its stroke burden increase. The aging of the population suggests an increase in cases for the years to come (knowing that stroke affects young people too). If it is possible, a study on disability and its projection in the years to come would complete this study of incidence and would produce interesting results.

To improve the data obtained, it is important to set up a media awareness campaign, to develop, in addition to the means of primary and secondary prevention, systems of care in sectors concerning both alert, transportation and hospital care.

The evaluation of the satisfaction of the loved one with the quality of life of the injured person has brought to light an almost similar similarity in the areas of satisfaction, dissatisfaction and discomfort between the patients and their relatives. That is to say that the relatives are satisfied with the capacity of the patients to assume their personal needs (ADL) and the relationship of the wounded with his family. On the other hand, the dissatisfaction of the relatives concerns the emotions and the feelings of the patient and they are more embarrassed by the emotional troubles of the patient (anger, aggressiveness, depression, anxiety). The impact of psychopathology on the quality of a patient’s life is considerable. Depression, anxiety et alexithymia are negative prognostic factors for the quality of life of the patient’s stroke. On the other hand, good self-esteem, the implementation of adaptive and effective adjustment strategies and personal work on oneself (psychotherapy) are predictive factors for a satisfactory quality of life (Mènon et al., 2015; Trystula, 2018).

CONCLUSIONS

Rehabilitation was effective and is very important because it improves cognitive functions such as nonverbal skills, visuospatial and strategic attention, and the digit memory and it also improves the patients’ quality of life.

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