Research Article

The Impressive Factors On Functional Recovery Of The Upper Extremity In Hemiplegic Patients

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Abstract

The purpose of this study was to describe the association between motor and sensorial impairment, to establish the relation to age, hemiplegic side, gender and emotion in ischemic stroke and to determine the factors, influences the recovery of the upper extremity functions in the hemiplegic patients. A total of 112 hemiplegic patients with the condition that at least 6 months were left from the onset of the stroke were assessed.

Sensorial and motor functions of the upper extremity were examined by using the Fugl-Meyer (FM) Upper Extremity Performance Test, sensorial function test and the Motricity Index. FM motor and sensorial scores were correlated significantly with Motricity index (p<0.05).

It was concluded that the age, hemiplegic side and emotional status are important factors that effects the recovery of the upper extremity in hemiplegic patients.

Keywords: Hemiplegia, upper extremity, sensorimotor assessment, functional recovery

Hemiplejik Hastalarda Üst Ekstremite Fonksiyonel Geri Dönüşünü Etkileyen Faktörler

Özet

Bu çalışmanın amacı, iskemik inmede yaşa, hemiplejik taraфа ve emosyona göre sensorimotor bozukluklar arasındaki ilişkiye belirlemek ve hemiplejik hastalarda üst ekstremite fonksiyonlarının geri dönüşünü etkileyen faktörleri saptamaktır. İnmeden sonra en az 6 ay zaman geçmiş toplam 112 hemiplejik hasta değerlendirilmiştir. Üst ekstremitenin duydu ve motor fonksiyonlarını Fugl-Meyer (FM) Üst Ekstremite Performans Test, duyusal fonksiyon testi ve Motricity Indeksi ile değerlendirilmiştir. FM motor ve duyusal skorları Motricity indeksi ile anlamlı korelasyon göstermiştir (p<0.05). Motor ve duyusal bozukluklar yaş, hemiplejik taraf ile ilişkili olmayıp FM (motor-duyusal), Motricity indeksi ve emosyonel durum arasında anlamlı korelasyonlar saptanmıştır (p<0.05). Emosyonel durumu iyi olan hastalar, sensorimotor fonksiyon testlerinden daha yüksek puanlar almış ve gruplar arasında anlamlı fark görülmüştür (p<0.05). Çalışmanın sonucunda yaş, hemiplejik taraf ve emosyonel durumun üst ekstremitede geri dönüşü etkileyen önemli faktörler olduğu tespit edilmiştir.

Anahtar Kelimeler: Hemipleji, üst ekstremite, sensorimotor değerlendirme, fonksiyonel geri dönüş
INTRODUCTION

Motor recovery after stroke may differ. Degree of the motor recovery depends on severity of the initial neurological damage and duration until the first voluntary movement\(^{(22,24)}\).

Most patients experience some natural recovery of neurologic functioning and improvement in ability to perform activities of daily living\(^{(10,14,25)}\).

Some authors have shown that increased age predicts poor outcome after stroke\(^{(1)}\). In addition to age, the side of lesion also appears strongly related to functional outcomes. Patients with severe functional impairment on admission following right hemisphere lesions appear to demonstrate less improvement than those with left hemisphere lesions\(^{(11)}\). Although these findings are not unique\(^{(26)}\), some researchers have not found a difference in outcome related to lesion location\(^{(31)}\) and recent literature reviews suggest that hemisphere of stroke does not predict outcome\(^{(11,26)}\). The study was designed to describe the association between motor function and ability to perform activities of daily living, and secondly to describe the association between gender, emotional status, age and lesion location (left vs right).

METHODS

Patients

Study population comprised a total of 112 of those hemiplegic patients, who had a sudden vascular-originated cerebral lesion, hospitalized in Cerebrovascular Disorder clinic at Neurology Department of Dokuz Eylul University Hospital. Patients and patient’s close relatives were informed about the study to be conducted and get their signed informed consent.

Criteria applied for selection of the subjects for this study were as follows: At least six months should have passed after stroke, patients must have either unilateral hemiplegia or hemiparesis, patient must be conscious and willing to cooperate.

Procedures:

Sensorimotor Evaluation and emotional status assessment were included:

1. Sensorial Evaluation: Regarding patient’s upper extremity, sense by touch, sense of pain, position and movement sense, stereognosis, graphesthesia, ability to differentiate right-left side, finger and body part recognition test were examined\(^{(21,22)}\).

2. Motor Evaluation: Performance of upper extremity was evaluated by means of Fugl-Meyer motor evaluation scale and Motricity index\(^{(13,22,29)}\). In Fugl-Meyer upper extremity performance testing, the movements that the patient able to perform were scored as successful-able to perform (2 points), partially successful-able to perform (1 point), and unsuccessful-not able to perform (0 point)\(^{(26)}\).

3. The highest grade that a patient could get in terms of shoulder and elbow functions in Fugl-Meyer scale was 36 points while 19 points and higher meant that the patient in question demonstrated motor recovery in upper extremity\(^{(7)}\). Hence, based on the assumption that recovery would develop after 4th phase, patients were divided into two groups as patients who recovered, and patients without recovery to observe and evaluate the factors affecting recovery.

4. Emotional Condition: At this stage patients asked to define how they perceive their health condition. Patients were asked, “How do you feel in regard to your health condition nowadays?” and to choose the suitable option in a 5-grade scale. Options were 5=very good, 4= good, 3= not very good, 2= bad, 1= very bad\(^{(6)}\).

In order to determine the effect of age on recovery patients were divided into three groups; first one comprised patients, who were 54 and younger, second group with...
patients between 55-64 of age, and third group was those, who were 65 and older.

**Statistical Analyses:**
All analyses were conducted using the SPSS 11.0 package. Pearson correlation analysis was performed to determine the associations between FM motor-sensory function, and Motricity index, logistic regression analysis was used to determine the effect of age, gender, hemiplegic side and emotion on the recovery from stroke. Statistical analyses were interpreted on the basis of the significance less than 0.05 (p<0.05).

**RESULTS**
The results of sensorimotor and perceptual evaluation scores were listed in Table 1. Fourty-nine (49) women (43.8 %) and 63 men (56.2 %) were enrolled consecutively. The mean age of patients was 65.52±10.32 (36-88) years. The patients were divided into three groups according to the ages and, who were 54 years and younger were 14.3 %, between 55-64 of ages were 27.7 %, and 65 years and older were 58 % of the subjects.

Logistic regression analysis were performed in order to identify the factors affecting recovery of upper extremity functions. As a result of these analysis it was ascertained that patient’s age (p=0.012), affected upper extremity (p=0.033) and patient’s emotional condition (p=0.000) significantly affected the motor recovery (Table 2).

**Table 1:** Overall Assessment Results of the Subjects

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensorial Function</td>
<td>17.63 ± 5.69</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Superficial Touch Sense</td>
<td>1.40 ± 0.60</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pain Sense</td>
<td>1.40 ± 0.60</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Kinesthetic Sense</td>
<td>14.70 ± 5.30</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Stereognosis</td>
<td>7.0 ± 3.50</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Graphesthesia</td>
<td>0.80 ± 0.40</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Finger Identification</td>
<td>2.70 ± 0.80</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Right – Left differentiation</td>
<td>4.70 ± 1.0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Motor Function</td>
<td>41.50 ± 19.7</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Shoulder-Elbow functions</td>
<td>27.21 ± 10.8</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>Wrist Function</td>
<td>6.2 ± 4.3</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Grasp Function</td>
<td>8.7 ± 5.7</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Motricity Index</td>
<td>64.03 ± 26.22</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 2:** Influencing Factors that effect the Functional Recovery of Upper Extremity

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>SE</th>
<th>% 95 CI</th>
<th>p</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54 years and below(R)</td>
<td>-2.653</td>
<td>1.603</td>
<td>0.003 – 1.631</td>
<td>0.098</td>
<td>0.070</td>
</tr>
<tr>
<td>55-64 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 years and above</td>
<td>-3.962</td>
<td>1.584</td>
<td>0.001 – 0.425</td>
<td>0.012*</td>
<td>0.019</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-1.027</td>
<td>0.796</td>
<td>0.075 – 1.704</td>
<td>0.197</td>
<td>0.358</td>
</tr>
<tr>
<td><strong>Hemiplegic Side</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>1.609</td>
<td>0.753</td>
<td>1.142 – 21.881</td>
<td>0.033*</td>
<td>5.000</td>
</tr>
<tr>
<td>Right(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emotional status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad</td>
<td>4.907</td>
<td>1.315</td>
<td>10.284 – 1779.255</td>
<td>0.000*</td>
<td>135.267</td>
</tr>
<tr>
<td><strong>Recovery (constant)</strong></td>
<td>-3.383</td>
<td>2.769</td>
<td></td>
<td>0.222</td>
<td>0.358</td>
</tr>
</tbody>
</table>

* statistically significant at the 0.05 level
Regarding patients over 65 year age, probability of having no recovery was 0.019 times greater than younger patients; for patients with left hemiplegia it is 5 times greater than right hemiplegia (Table 2).

According to the self-perception of general health status, as emotional status, 56.3 % patients mood were good and 43.8 % patients mood were bad. For those patients whose emotional condition relatively worst than others probability having no upper extremity motor recovery was 135 times greater than those with better emotional conditions (Table 2).

Nevertheless gender would not have a significant effect on recovery of functions (p>0.05) (Table 2).

There was no significant correlation between the functional scores and hemiplegic side, age, gender (Table 3).

It was determined a significant correlation between emotional and sensorimotor status (FMmotor p<0.01, r= -0.538) (FMsensorial p<0.01, r= -0.369) (FMtotal p<0.01, r= -0.545) and (Motricity Index p<0.01, r= -0.475) (Table 3).

Significant correlations were determined between sensorimotor scores and Motricity index (p=0.000) (Table 3).

Sixty-six patients (58.9 %) were right hemiplegic and 46 patients (41.1 %) were left hemiplegic. According to the mean score of Motricity index, the FM motor function test and the FM sensorial scores for right and left hemiplegic patients, significant difference was found between two groups (p=0.013), (p=0.033), (p=0.024) (Table 4).

### Table 3: Correlation Coefficients of the Sensorimotor Scores to the Patients Characteristics and Motricity Index

<table>
<thead>
<tr>
<th></th>
<th>Fugl-Meyer Motor score</th>
<th>Fugl-Meyer Sensorial score</th>
<th>Fugl-Meyer Total score</th>
<th>Motricity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>0.105</td>
<td>0.003</td>
<td>0.070</td>
<td>0.068</td>
</tr>
<tr>
<td>Hemiplegic side</td>
<td>-0.111</td>
<td>-0.124</td>
<td>-0.120</td>
<td>-0.137</td>
</tr>
<tr>
<td>Gender</td>
<td>0.105</td>
<td>-0.016</td>
<td>0.072</td>
<td>0.033</td>
</tr>
<tr>
<td>Emotional status</td>
<td>-0.538*</td>
<td>-0.369*</td>
<td>-0.545*</td>
<td>-0.475*</td>
</tr>
<tr>
<td>Motricity Index</td>
<td>0.878*</td>
<td>0.495*</td>
<td>0.878*</td>
<td></td>
</tr>
</tbody>
</table>

* correlation is significant at the 0.05 level (2-tailed)

### Table 4: The Sensorimotor Scores According to The Hemiplegic Side of The Patients

<table>
<thead>
<tr>
<th></th>
<th>Motricity Index</th>
<th>FMm**</th>
<th>FMs**</th>
<th>FMt**</th>
</tr>
</thead>
<tbody>
<tr>
<td>R hemiplegic side</td>
<td>69.07±21.35</td>
<td>44.81±16.73</td>
<td>33.72±10.18</td>
<td>79.07±22.25</td>
</tr>
<tr>
<td>L hemiplegic side</td>
<td>56.63±30.70</td>
<td>36.78±22.71</td>
<td>31.45±9.87</td>
<td>68.19±30.21</td>
</tr>
<tr>
<td>p</td>
<td>0.013*</td>
<td>0.033*</td>
<td>0.024*</td>
<td>0.036*</td>
</tr>
</tbody>
</table>

* statistically significant at the 0.05 level
** FMm= Fugl-Meyer motor score, FMs= Fugl-Meyer sensorial score, FMt= Fugl-Meyer total score
DISCUSSION

Since the functional disorder caused by stroke depends on the affected cerebral artery only those functions on the related area will be affected. Depending on having the lesion on either left or right hemisphere different clinical cases will occur and recovery of affected functions will differ. Recovery after stroke is affected by such factors as patient’s age, density of the lesion and location of the lesion.

Fugl-Meyer upper extremity performance test evaluates voluntary motor functions (degree of the synergy, ability to coordinate voluntary functional movements). The Brunnstrom-Fugl Meyer test is based on the observation that motor recovery occurs according to predictable stages, each evaluated by a set of items. Since results of Fugl-Meyer scale and Activities of Daily Living (ADL) have strong correlation with performance capacity and somatosensory-evoked potentials, these tests are considered as valid and reliable\(^{(9,11,12)}\). Motricity index, which evaluates motor power of upper extremity, is known as being very sensitive, simple and used in a wide range of application to determine functional recovery after stroke\(^{(29,30)}\).

Somatosensorial measurements, which are widely used to evaluate sensorial functions, include proprioceptive sense and light touch while two-point discrimination test is the least used sensorial test\(^{(31)}\). It was choosen to use these functional tests because of they known as valid, reliable and sensitive to the functional progress.

Differences in association between age and functional status across studies might be due to the correlation of age with comorbidities such as medical, psychosocial and psychiatric disorders which may not emerge an independent predictors of outcome and causes physical intolerance and delay of functional recovery in intensive rehabilitation\(^{(1,2,28)}\). Similarly Kotila showed that patients over 65 years had a significant negative impact on discharge from hospital, adequate performance of ADL and return to work\(^{(18)}\). Bagg and Macchiocchi have demonstrated that older age has caused weak functional outcomes and constituted a risk factor for functional independence, who were given a rehabilitation programme in their acute phase\(^{(2,20)}\). Lindmark and colleagues have mentioned that males have stroke at relatively younger ages compared to females, and males have little life expectancy than females after stroke\(^{(19)}\). In this study, it has been ascertained that younger patients demonstrated better recovery compared to older patients, and recovery potential would lessen as the patient gets older. This conclusion goes parallel with Bagg and Macchiocchi’s studies.

Deshelton, Yavuzer and Katrak have ascertained that gender has no significant impact on motor recovery and functional level\(^{(7,16,33)}\). Contrary to that, Wyller and colleagues have mentioned that gender factor is only significant in subacute phase. They argued that this was because of inflammatory reply occurred after cerebral ischemia, which was observed in animal trials, was stronger in females compared to males\(^{(32)}\). In this study, we have concluded that gender has no significant impact on recovery. As a result of our evaluations we have found that whilst female subjects, 43.8 % of the study population, had greater grades compared to male subjects but this does not mean it is significant enough (p>0.05). This also complies with the literature knowledge in regard to females having more widespread hemispheric organisation after stroke compared to males\(^{(23)}\). It was determined that 81.6 % of females and 71.6 % males had experienced the recovery. Also, the reason why there was no significant difference between groups in terms of recovery degree could be related that right hemiplegic patients, consist of 60.6 % of male and 39.4 % females. And it was
determined those patients with right hemiplegia showing greater degree of recovery.

Motor functions in patients with stroke may differ depending on which cerebral hemisphere is impacted. As for patients with right hemiplegia, obligatory dominance, that is being obliged to use nondominant extremity, negatively affects the functions. Therefore, patients with left hemiplegia have better functional performance compared to patients with right hemiplegia\(^8\). Zemke et al have been described that, stroke patients with right arm involvement; smaller ipsilateral (nonstroke) premotor and larger contralateral (stroke-side) sensorimotor activation compared with left arm involvement. They also suggested that side of stroke and final motor status are related to motor system reorganization after stroke\(^{34}\). Macchiocchi has concluded that patient with stroke whose left hemisphere is effected, have weaker functional outcomes compared to those whose right hemisphere is effected. This difference is because of the fact that lesion causes disorder in perceptions, and such behavioral problems as anosognosis and abulia\(^{20}\). As a result of this study it was determined that right hemiplegic patient are more likely to recover compared to left hemiplegic patients and hemiplegic side significantly affect recovery of upper extremity functions. Findings revealed that 83.3 % of patients with right hemiplegia presented recovery while 65.2 % of patients with left hemiplegia recovered. These results were similar with results of Macchiocchi’s study, and the other source\(^{21}\), indicating that sensorial and motor functional disorder would be more severe in right hemisphere lesion for results of our study have revealed that whilst patients with right hemiplegia had greater but not significant sensorial, perceptual and motor grades compared to patients with left hemiplegia.

Emotional outcome is a critical factor influencing early evolution and late prognosis after stroke. Mood changes, modified judgment and emotional reactions may also dramatically alter recruitment into clinical trials. Late depression is the most common mood alteration during the first year after stroke and critical for the functional improvement of individual patients. There is a strong link between depression and poor functional outcome of the patients and depression can lead to a worse functional outcome\(^{4,5,27}\). Kauhanen and colleagues have mentioned that depressive patients are relatively older and more severe neurological disorders\(^{17}\). Berg and colleagues states that severity of stroke and functional disorder is related with depression yet development of depression has nothing to do with location of the lesion\(^3\). Our findings revealed that patients with emotional distress had lower points in sensorial, perceptual and motor tests compared to those patients with better emotional conditions. Hence it has been observed that emotional condition is an important factor affecting recovery in upper extremity functions similar with the literature (p<0.05).

Similar to conclusion that nondominant hemisphere has a significant impact on space perception, proprioception and orientation as well as emotional condition\(^{15}\). In this study it was found that 63.5 % of right hemiplegic patient and 36.5 % of left hemiplegic patients have better emotional conditions (p>0.05).

**CONCLUSION**

It has been observed that the major factors affecting recovery of upper extremity motor functions were age, hemiplegic side, and emotional conditions. These factors have appeared to be a key role in planning rehabilitation programmes for hemiplegic patients and success thereof.
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