CORRELATION OF DEEP TENDON REFLEXES AND THE DURATION AFTER STROKE IN STROKE PATIENTS
(Case Study in Saiful Anwar Hospital)

Shahdevi Nandar Kurniawan*, Nanik Setijowati**, Khoo Phong Jhiew***

ABSTRAK

Penurunan fungsi motorik setelah stroke biasanya membaik selama periode waktu dan perbaikan mungkin berbeda antara pasien stroke iskemik dan hemorragik. Refleks abnormal yang berhubungan dengan spastisitas dianggap sebagai penentu utama penurunan fungsi motorik kontralateral, sehingga refleks tendon dalam yang ditimbulkan mungkin juga berbeda antara pasien stroke iskemik dan hemorragik selama periode waktu setelah stroke. Tujuan dari penelitian ini adalah untuk menganalisis hubungan refleks tendon dalam yang terkait dengan jenis stroke dan jangka waktu setelah stroke. Penelitian ini merupakan penelitian observasional analitik dengan desain cross-sectional untuk menganalisis perbedaan refleks tendon dalam pasien stroke iskemik dan hemorragik dan perbedaan refleks tendon dalam berdasarkan jangka waktu setelah stroke. Sampel diperoleh dengan menggunakan consecutive sampling yang termasuk 60 pasien stroke (30 pasien stroke iskemik dan 30 pasien stroke hemorragik) dengan jangka waktu setelah stroke 1 bulan, 2 bulan, dan 3 bulan (10 pasien pada setiap jenis stroke). Hasil penelitian menunjukkan bahwa perbedaan refleks tendon dalam pasien stroke iskemik dan hemorragik tidak signifikan (chi-square, \( p > 0,121 \)), sedangkan perbedaan refleks tendon dalam berdasarkan jangka waktu setelah stroke adalah signifikan (chi-square, \( p < 0,029 \)). Kesimpulannya adalah bahwa ada perbedaan yang signifikan pada refleks tendon dalam berdasarkan jangka waktu setelah stroke tetapi tidak ada perbedaan yang signifikan pada refleks tendon dalam pasien stroke iskemik dan hemorragik.

Kata kunci: penurunan fungsi motorik, stroke iskemik, stroke hemorragik, jangka waktu setelah stroke, refleks tendon dalam

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ABSTRACT

Motor impairment after stroke is usually improved over a period of time and the improvement might differ between ischemic and hemorrhagic stroke patients. As abnormal reflexes associated with spasticity were considered to be the major determinant of contralateral motor impairment, the deep tendon reflexes elicited might differ as well between ischemic and hemorrhagic stroke patients over a period of time after stroke. The objective of this study is to analyze the relationship of deep tendon reflexes related to types of stroke and duration after stroke. This research is an analytical observational study using cross-sectional design to analyze the difference of deep tendon reflexes of ischemic and hemorrhagic stroke patients and difference of deep tendon reflexes based on duration after stroke. Sample was acquired using consecutive sampling which included 60 stroke patients (30 ischemic and 30 hemorrhagic stroke patients) with duration after stroke of 1 month, 2 months, and 3 months (10 patients each in each type of stroke). The results indicated that the difference of deep tendon reflexes of ischemic and hemorrhagic stroke patients is not significant (chi-square, $p > 0.121$), while the difference of deep tendon reflexes based on duration after stroke is significant (chi-square, $p < 0.029$). The conclusion is that there is a significant difference of deep tendon reflexes based on duration after stroke but there is no significant difference of deep tendon reflexes of ischemic and hemorrhagic stroke patients.

Keywords: motor impairment, ischemic stroke, hemorrhagic stroke, duration after stroke, deep tendon reflexes

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INTRODUCTION

Formerly, stroke is known as one of the major causes of morbidity and mortality in Indonesia.\textsuperscript{1} After the review of recent surveys, stroke is now the leading cause of mortality in Indonesia which overtook the number of death caused by heart diseases and cancer.\textsuperscript{2}

According to Dr. Herman Samsudin, Sp.S, a neurologist and the president of Jakarta division of Yayasan Stroke Indonesia (Yastroki), Indonesia has the highest number of stroke patients in the world.\textsuperscript{3} The latest study reviewed that stroke is the leading cause of mortality among Indonesians above five years of age and 15.4\% of total mortality in Indonesia is caused by stroke with the stroke prevalence of 0.022\% in urban Indonesia, 0.017\% in rural Indonesia, 0.5\% among urban Jakarta adults, and 0.8\% overall.\textsuperscript{4}

Generally, stroke is divided into ischemic and hemorrhagic origins.\textsuperscript{5} Ischemic stroke is due to a blocked artery thus deprives the brain cells of their blood supply. Meanwhile, hemorrhagic stroke is due to bleeding in or around the brain.\textsuperscript{5}

The loss of function including motor impairment after stroke is common and over days to months some function is usually regained.\textsuperscript{5} The outcome of functional improvement might differ between ischemic and hemorrhagic stroke patients, if a hemorrhagic stroke is not massive and intracranial pressure is not very high, outcome is likely to be better after than that of an ischemic stroke.\textsuperscript{5}

With account to the different outcomes of functional improvement including motor function improvement between ischemic and hemorrhagic stroke patients over a period of time, the result of elicited deep tendon reflexes might differ as well. Reinforcement of these possibilities is verified in early studies which described that abnormal reflexes associated with spasticity were considered to be the major determinant of contralateral motor impairments in stroke patients.\textsuperscript{5, 6}

Currently, deep tendon reflexes examination is only used as aid in anatomical diagnosis of a neurological disorder to whether the disorder originated from central or peripheral nervous system.\textsuperscript{7} If the reflex intensity differences were to
be studied between ischemic and hemorrhagic stroke patients, the possibilities of acquire the use of deep tendon reflexes examination as a tool in evaluating motor function improvement over a period of time, and as an aid in determination of stroke prognosis in ischemic and hemorrhagic stroke patients, can be increased.

The general objective of this study is to analyze the relationship of deep tendon reflexes related to types of stroke and duration after stroke.

If the hypothesis can be proven significant, the deep tendon reflexes examination can be used as an alternative and / or supportive examination in evaluation of motor function improvement. Apart from that, it can also determine stroke prognosis, as it is inexpensive and time efficient to be carry out.

**METHODOLOGY**

This study is an analytical observational study using cross-sectional design. The sampling method used in this study is consecutive sampling. The study was carried out at the Neurology Policlinic of Saiful Anwar Hospital (Rumah Sakit Saiful Anwar) from May 2010 to October 2010. The sample of this study is defined as first-ever stroke patients that were admitted into Saiful Anwar Hospital (Rumah Sakit Saiful Anwar) in the year of 2010, which satisfied the inclusion criteria and do not fulfill the exclusion criteria, and agreed to enter the study.

The inclusion criteria includes first-ever stroke; age not more than 85 years; 1st month, 2nd month, or 3rd month after stroke; involvement of anterior and / or middle cerebral artery territory; and hemiparesis. While the exclusion criteria includes other neurological impairments with permanent damage; stroke-like symptoms; diabetic neuropathy; admission to hospital more than 6 weeks after stroke; no informed consent; pre-stroke Barthel Index less than 50; and signs of cerebral shock / acute phase of stroke.

Data of difference between deep tendon reflexes, types of stroke, and duration after stroke is analyzed using chi-square test or Fisher’s exact test or exact contingency table test; the latter two tests are used if there is one or more cell with value less than 5. The test is carried out with 95% confidence.
level, where $\alpha = 0.05$ and the result is significant when $p < 0.05$.

**RESULT**

The data collected is analyzed using SPSS Statistics 17.0 for chi-square test; and using online calculator from College of Saint Benedict and Saint John’s University, Minnesota, USA, and SPSS Statistics 17.0 for the Fisher’s exact test.

The result shows a significant difference of deep tendon reflexes (grade / progression) based on duration after stroke (1st month, 2nd month, and 3rd month) with $p = 0.002$, while there is no significant difference of deep tendon reflexes (grade / progression) of stroke patients (ischemic and hemorrhagic) with $p = 0.375$.

Besides that, the deep tendon reflexes (abnormality) based on duration after stroke (1st month, 2nd month, and 3rd month) also found to be significant with $p = 0.001$, but there is also no significant difference of deep tendon reflexes (abnormality) of stroke patients (ischemic and hemorrhagic) with $p = 0.121$.

Data collected from May 2010 to October 2010 at Policlinic of Neurology of Saiful Anwar Hospital (Rumah Sakit Saiful Anwar) with total samples of 60 subjects are presented in Figure 1, Figure 2, and Figure 3.

The summary of results of the relationship of deep tendon reflexes intensities with types of stroke and duration after stroke is tabulated in Table 1.

Figure 1: Distribution of Deep Tendon Reflexes Intensities (Grade) based on Duration after Stroke and Types of Stroke
Figure 1, Figure 2, and Figure 3 show the distribution of deep tendon reflexes intensities (grade / progression / abnormality) of 60 samples based on the duration after stroke (1\textsuperscript{st} month, 2\textsuperscript{nd} month, and 3\textsuperscript{rd} month) and types of stroke (ischemic and hemorrhagic).

The categories of deep tendon reflexes used in this study are tabulated as in Table 2.
Table 1: Relationship of Deep Tendon Reflexes Intensities with Types of Stroke and Duration after Stroke

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variables</th>
<th>Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep Tendon Reflexes Intensities (Grade / Progression)</td>
<td>Duration after Stroke (1st Month, 2nd Month, and 3rd Month)</td>
<td>Types of stroke (Ischemic and Hemorrhagic) 0.002 *</td>
</tr>
<tr>
<td></td>
<td>Types of Stroke (Ischemic and Hemorrhagic)</td>
<td>Ischemic Stroke 0.064</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hemorrhagic Stroke 0.067</td>
</tr>
<tr>
<td></td>
<td>Duration after Stroke (1st Month, 2nd Month, and 3rd Month)</td>
<td>1st Month 0.700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd Month 0.714</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd Month 0.582</td>
</tr>
<tr>
<td>Deep Tendon Reflexes Intensities (Abnormality)</td>
<td>Duration after Stroke (1st Month, 2nd Month, and 3rd Month)</td>
<td>Types of stroke (Ischemic and Hemorrhagic) 0.001 *</td>
</tr>
<tr>
<td></td>
<td>Types of Stroke (Ischemic and Hemorrhagic)</td>
<td>Ischemic Stroke 0.029 *</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hemorrhagic Stroke 0.029 *</td>
</tr>
<tr>
<td></td>
<td>Duration after Stroke (1st Month, 2nd Month, and 3rd Month)</td>
<td>1st Month 0.291</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd Month 0.328</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd Month 0.291</td>
</tr>
</tbody>
</table>

Note: * indicates significant value with p < 0.05

Based on Figure 1 and Figure 2, at 1 month after stroke, most patients (11 out of 20 patients) were found to have grade +3 / “increased” deep tendon reflexes intensity, with 6 ischemic stroke
patient and 5 hemorrhagic stroke patients. While, at 2 months after stroke, most patients (10 out of 20 patients) were found to have grade +2 / “normal” deep tendon reflexes intensity, with 4 ischemic stroke patients and 6 hemorrhagic stroke patients. Lastly, at 3 months after stroke, most patients (16 out of 20 patients) were found to have grade +2 / “normal” deep tendon reflexes intensity, with 7 ischemic stroke patients and 9 hemorrhagic stroke patients, while there was none found with grade +4 / “pathologic”.

Based on Figure 3, at 1 month after stroke, most patients (16 out of 20 patients) were found to be “abnormal” in deep tendon reflexes intensity, with 9 ischemic stroke patient and 7 hemorrhagic stroke patients. While, at 2 months after stroke, 50% of the patients (10 out of 20 patients) were found to be “abnormal” in deep tendon reflexes intensity, with 6 ischemic stroke patients and 4 hemorrhagic stroke patients; and the other 50% of the patients (10 out of 20 patients) were found to be “normal” in deep tendon reflexes intensity, with 4 ischemic stroke patients and 6 hemorrhagic stroke patients. Lastly, at 3 months after stroke, most patients (16 out of 20 patients) were found to be “normal” in deep tendon reflexes intensity, with 7 ischemic stroke patients and 9 hemorrhagic stroke patients.

Table 2: Categories of Deep Tendon Reflexes (Grade, Progression, and Abnormality)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Progression</th>
<th>Abnormality</th>
<th>Descriptions / Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>+2</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>+3</td>
<td>Increased</td>
<td>Abnormal</td>
<td>Increased but not necessarily to a pathologic degree</td>
</tr>
<tr>
<td>+4</td>
<td>Pathologic</td>
<td>Abnormal</td>
<td>Markedly hyperactive, pathologic, often with extra beats or accompanying sustained clonus</td>
</tr>
</tbody>
</table>
DISCUSSION

Based on the cross-sectional study from May 2010 to October 2010 at Policlinic of Neurology of Saiful Anwar Hospital (Rumah Sakit Saiful Anwar); a total of 60 patients (100%) are examined, where 30 patients (50%) are ischemic stroke patients and the other 30 patients (50%) are hemorrhagic stroke patients; and out of the 60 patients (100%), 20 patients (33.33%) are of a month after stroke, 20 patients (33.33%) are of 2 months after stroke, and 20 patients (33.33%) are of 3 months after stroke; whom are equally (10 patients each) made up from ischemic and hemorrhagic stroke patients.

The data collected shows a pattern of increase in prevalence of stroke patients with normal deep tendon reflexes intensities and decrease in prevalence of stroke patients with abnormal deep tendon reflexes intensities, who have passed one, two, and three months after stroke happens. The pattern can be explained with the recovery of penumbra area in the brain, and plasticity which might occur in certain unaffected areas of the brain which switch the functions previously performed by the damaged areas.\(^5\)

Comparison of the prevalence of ischemic stroke patients with normal deep tendon reflexes intensities who have passed one, two, and three months after stroke happens (40%) and the prevalence of hemorrhagic stroke patients with normal deep tendon reflexes intensities who have passed one, two, and three months after stroke happens (60%); shows a prevalence difference of 20%. This can be explained with the greater chance of functional improvements in hemorrhagic stroke patients compares to ischemic stroke patients, if a hemorrhagic stroke is not massive and intracranial pressure is not very high.\(^5\)\(^,\)\(^9\)

Besides that, several other literatures stated a different opinion, they mentioned that the outcome of stroke is difficult to predict but, in general besides the type of stroke, age, pre-stroke co-morbidity, severity of stroke, duration of obstruction or hemorrhage, and risks related to recurrent stroke are associated with prognosis of physical recovery including abnormal reflexes associated with spasticity that are considered to be a major determinant of contralateral motor impairments in stroke patients.\(^6\),\(^10\),\(^11\)
The concepts of brain plasticity demonstrated that neuronal cortical connections can be remodeled by our experience including activities of daily living (ADL), instrumental activities of daily living (IADL), learning, and others.\textsuperscript{12} A study conducted supported this theory with animals housed to represent human adults in complex environments with access to various instruments and activities develop more dendritic branching and more synapses per neuron and have higher gene expression for trophic factors than animals housed individually or in small groups in standard cages.\textsuperscript{12} Besides that, the concepts of brain plasticity also demonstrated that cortical representation areas can be modified by sensory input, experience, learning, and in response to brain lesions including stroke.\textsuperscript{12}

Most stroke patients with motor deficits including hemiparesis, incoordination, and spasticity, recover at least some of the lost motor function over time with variable degree.\textsuperscript{13} There is evidence that with post-stroke motor rehabilitation, patients can enhance their motor recovery.\textsuperscript{13} Brain mapping studies in patients have revealed that the brain reorganizes after stroke in relation to recovery of motor function through brain plasticity.\textsuperscript{13}

Both spontaneous and rehabilitation-induced motor recovery in stroke patients with motor impairments can involve a shift in brain activity toward more normal function and compensatory changes that result in patterns of brain activity that diverge from normality, for example, greater than normal activity in ipsilateral sensorimotor cortices and contralateral secondary motor cortices.\textsuperscript{12, 13} It is debatable if motor rehabilitation is efficacious by promoting the same neural processes that underlie spontaneous recovery which involve a shift in brain activity toward more normal function, or by promoting compensatory changes in brain activity that would not occur spontaneously.\textsuperscript{12, 13} In conclusion, the efficacy of post-stroke motor rehabilitation depends on several variables, including the rehabilitation approach, neural status of the patient, and duration after stroke.\textsuperscript{12, 13}
CONCLUSION
1. The difference of deep tendon reflexes (grade, progression, and abnormality) of stroke patients (ischemic and hemorrhagic); is proven to be not significant.
2. The difference of deep tendon reflexes (grade, progression, and abnormality) based on duration after stroke; is proven to be significant.

SUGGESTION
- Deep tendon reflexes examinations should be carried out in every visit of stroke patients after acute phase, the intensities elicited should be recorded, and together with other clinical and laboratory data to provide a better stroke prognosis or functional recovery including motor function improvements of the patients.
- Study involving correlation between motor function and deep tendon reflexes intensities of stroke patients should be carry out.
- Further studies related to the differences of ischemic and hemorrhagic stroke should be carried out to provide deeper understanding about the two types of stroke, a more specific management, and a more comprehensive stroke prognosis and rehabilitation.
- This study can also be carried out again with a larger sample size and longer time.
- The other factors that might contribute to the stroke prognosis can be further explore and a study involving all the factors contribute to stroke prognosis should be carry out inclusively.
- Post-stroke motor rehabilitation should be included in routine stroke therapy regime and the effect on motor recovery should be further studied.

REFERENCES


