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# Comparison of European Stroke Scale and Allen Prognostic Scale in predicting functional outcomes in stroke patients

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## Research Report

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**Purpose:** This study compares the ability of European Stroke Scale (ESS) and Allen Prognostic Scale (APS) to predict functional outcomes as measured by the Barthel Index (BI). **Material and method:** Twenty-four patients were included in this study. Their average age was 62.17±13.71 years. Subjects were evaluated at hospital admission, discharge and following 3 and 6 months after discharge with ESS, APS and BI. **Results:** Through the result of the statistical analysis; the differences between ESS and BI scores in 1<sup>st</sup> and 2<sup>nd</sup> assessment were found to be significant ( $p<0.05$ ), but the same for 3<sup>rd</sup> and 4<sup>th</sup> assessments were not significant ( $p>0.05$ ). Also, the difference between APS and BI scores in the 1<sup>st</sup> assessment was found to be significant ( $p<0.05$ ), 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> assessments were insignificant ( $p>0.05$ ). There was a correlation between ESS, APS and BI scores ( $p<0.01$ ), but there was a stronger correlation between ESS and BI scores than between APS and BI. We found a correlation only between APSs of the 3<sup>rd</sup> and 4<sup>th</sup> assessments and ages ( $p<0.05$ ). **Conclusion:** Our results demonstrate that ESS is simpler to use and is a better predictor of functional outcomes after 3 month. However, APS is a better predictor of functional outcomes from 1-30 days after stroke than ESS.

**Key words:** Stroke, European Stroke Scale, Allen Prognosis Scale, Barthel Index.

## Hemiplejik hastalarda fonksiyonel sonuçları tahmin eden European Stroke Skalası ve Allen Prognostik Skalalarının karşılaştırılması

**Amaç:** Bu çalışma European Stroke Skalası (ESS) ve Allen Prognostik Skalası (APS)'nin Barthel İndeksi (BI) ile belirlenen fonksiyonel sonuçları tahmin edebilme yeteneğini karşılaştırmaktadır. **Yöntem ve gereç:** Bu çalışmaya 24 hasta dahil edildi. Yaş ortalamaları 62.17±13.71 yıldır. Olgular hastaneye yattıklarında, taburcu olduklarında ve bunu takip eden 3. ve 6. aylarda ESS, APS ve BI ile değerlendirildi. **Sonuçlar:** İstatistiksel analiz sonucunda ESS ve BI'nin 1. ve 2. değerlendirmeleri arasındaki fark anlamlı bulunurken ( $p<0.05$ ), 3. ve 4. değerlendirmeler arasında anlamlı fark bulunmadı ( $p>0.05$ ). Ayrıca, APS ve BI'nin 1. değerlendirme sonuçları arasındaki fark anlamlı iken ( $p<0.05$ ), 2., 3. ve 4. değerlendirmeler arasında anlamlı fark bulunmadı ( $p>0.05$ ). ESS, APS ve BI arasında bir ilişki bulundu. Bu korelasyon ESS ve BI arasında daha kuvvetliydi. Olguların yaşları ile sadece APS'nin 3. ve 4. değerlendirmeleri arasında ilişki bulundu. **Tartışma:** Sonuçlar, ESS'nin kullanımının kolay ve fonksiyonel sonuçları 3 aydan sonra daha iyi tahmin edebildiğini gösterdi. Ancak inmeden sonraki 1-30. günlerde APS, ESS'den daha iyi fonksiyonel kapasiteyi tahmin etmektedir.

**Anahtar kelimeler:** İnme, European Stroke Scale, Allen Prognosis Scale, Barthel Index.

Stroke is a syndrome developing because of obstruction arising from thrombi or embolus, tearing or diseases of veins or arteries. Stroke causes loss of movement or/and sensation in upper and lower extremities in the contra lateral side of the damaged brain hemisphere, disturbances of balance and perception, and many other complications. Disturbances in sensation-perception-motor functions present as paresis/plegia, abnormal muscle tonus, and selective losses of movement.<sup>1,2</sup>

Recovery after stroke depends on the cause and persistence of this cause, size of the damaged brain tissue, health condition of the patient prior to the event, and to complications.<sup>3,4</sup> In the studies performed, it has been reported that recovery after stroke happens during the first 3-12 months, particularly in the first 3-4 months. Recovery pattern reaches a plateau pattern after this period. It is accepted that resuming the normal functional activities of the patients undergone a stroke as a result of rehabilitation programs started from the acute period takes one year or more.<sup>5-8</sup>

Deciding the intensity of the rehabilitation program in the direction of the information about the prognoses of the patients with stroke in the early period allows more efficient results. In addition, efficiency of the rehabilitation program can be evaluated under the light of such information, and unnecessary applications and economical losses can be prevented. There are many scales used for this purpose. Canadian stroke scale, Orpington stroke scale, Edinburgh prognostic score, Toronto stroke scale, The National Institutes of Health stroke scale, European Stroke Scale (ESS) and Allen Prognostic Scale (APS) are some of these.<sup>9-19</sup> A good scale must be capable of deciding the neurological disorder of the patient as well as providing information about the functional status of the patient in future. Therefore, many comparative studies are performed to decide the reliability, validity, and sensitivity of such scales.

ESS is a valid, reliable, and easy-to-apply scale that scores sub-parameters in a more comprehensive manner preferred in predicting the prognoses of the patients with stroke. In 1994,

Hantson et al have found that ESS is capable of functional results of the patients with stroke in 3<sup>rd</sup> and 6<sup>th</sup> months. Studies have been performed comparing ESS to other prognostic scales, and it has been found that ESS is more sensitive as compared to other scales, and more capable of predicting the prognosis.<sup>15-17</sup>

APS is a scale developed by Allen in 1984 in Guy's Hospital. This scale provides reliable information about determining the diagnosis as well as predicting the functional results after discharge of patients with stroke.<sup>18</sup> No studies comparing APS to other scales in the literature review performed.

Therefore, our study was performed to determine which of the two scales, namely ESS and APS, used in predicting the prognoses of patients with stroke, better showed the improvement in functional capacity.

## MATERIALS AND METHODS

Since 2001 thirty cases in the acute phase followed in the neurology clinic and diagnosed with stroke by a neurologist were included in this study; and patients having tumors in any part of the body and with any disorder in systems like cardiovascular, renal, or pulmonary system were excluded. Study was completed with 24 patients, since 2 patients died in the acute phase, and 4 patients could not be reached in control periods. Rehabilitation programs of the cases included in the study were performed till the end of the study by professionals during the hospitalization period and by home programs and controls after discharge. Baseline variables that were recorded presented in Table 1.

Total four ESS and APS assessments were performed on patients involved in our study on hospitalization (1<sup>st</sup> – 3<sup>rd</sup> days), on discharge (15<sup>th</sup> – 30<sup>th</sup> days following the stroke), on 3<sup>rd</sup> and 6<sup>th</sup> months after this. During these periods Barthel Index (BI) was used to determine the dependence level in the daily life activities. BI includes urine and stool incontinence parameters, which have an important prognostic value.

**Table 1. The demographic characteristics of patients (N=24).**

	X±SD
Age (years)	62.17±13.71
	n (%)
<b>Gender</b>	
Female	5 (20.8%)
Male	19 (79.2%)
<b>History</b>	
Hypertension	17 (70.8%)
Chronic Heart Failure	5 (20.8%)
Diabetes mellitus	6 (25.0%)
Stroke	9 (37.5%)
Coroner Artery Disease	7 (29.2%)
<b>Hemisphere affected</b>	
Right	14 (58.3%)
Left	10 (41.7%)
<b>Arterial localizations</b>	
Middle Cerebral Artery	13 (54.2%)
Anterior Communicant Artery	3 (12.5%)
Vertebral Artery	6 (25.0%)
Internal Carotid Artery	2 (8.3%)

ESS includes the assessment of consciousness levels, cooperation, speech, gazing, visual field, facial mobility, upper and lower extremity functions, and gait of the patients with stroke. It consists of four sections, and total score is obtained by adding the scores of each sections. The highest score that can be obtained from ESS is 100, indicating full recovery.

APS examines age, paralysis in extremities, level of consciousness, homonymous hemianopsy, and higher cerebral functions in order to determine the level of functional independence, and determines the recovery percentage of patients.

BI is used for evaluating the activities of the daily life. This test consists of 10 sections focusing on issues like self-care, sphincter control, and basic mobility. Cases get 0 score the lowest, and 100 the highest.<sup>19</sup>

#### Statistical analysis:

At the end of the study, scores obtained from ESS and APS were compared with each other

taking the results of BI as the basis. Wilcoxon Signed Ranks Test was used to compare the ESS and APS results with BI results. Mann-Whitney U test was used to compare the prognostic results of the cases with dominant and non-dominant lobe lesions. Pearson's Correlation Analysis was used to determine which one of ESS and APS predicted the prognosis better, and correlations of ESS and APS scores with BI score were determined. SPSS 11.00 statistics program was used in our study. The level of significant was set at 0.05.

## RESULTS

ESS, APS, and BI results of the cases upon admission to the hospital, at discharge, and in 3<sup>rd</sup> and 6<sup>th</sup> months after discharge are shown in graphic 1.

When ESS and APS assessment results are examined, statistically significant differences were found in the 1<sup>st</sup> and 2<sup>nd</sup> assessment results in ESS, and in the 1<sup>st</sup> assessment results in BI ( $p < 0.05$ ) (Table 2-3).

When the correlations of ESS and APS results with BI results were examined, it was found that a strong relationship existed for both, and this relationship was stronger between ESS and BI ( $p < 0.01$ ) (Table 4).

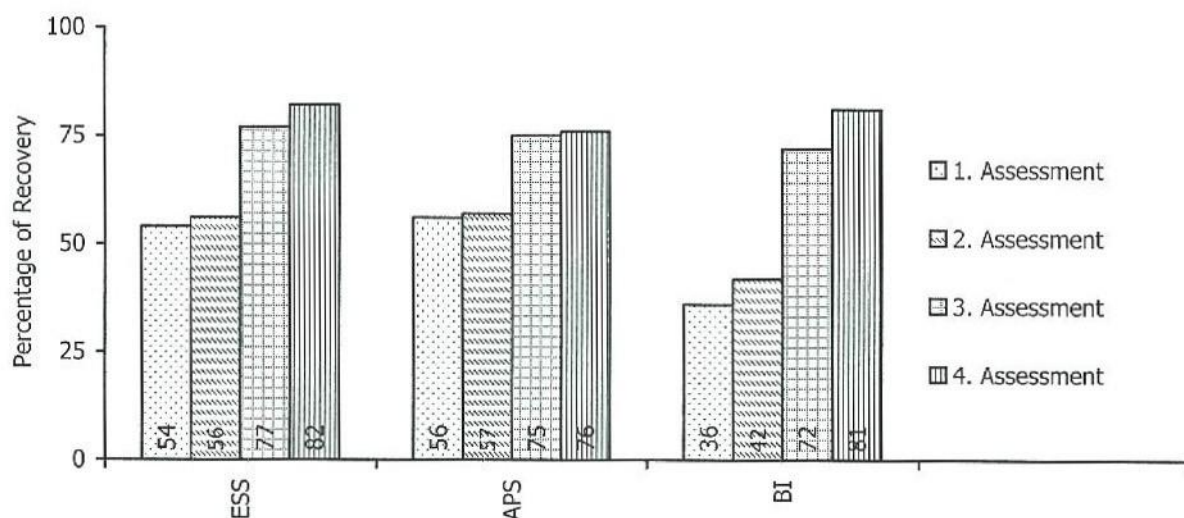
When the correlations between the ages of the cases and results of ESS and APS assessments were examined, it was found that a relationship existed only between the assessment results with APS in 3<sup>rd</sup> and 6<sup>th</sup> months and the ages of the cases ( $p < 0.05$ ) (Table 5).

Prognostic assessment results were compared also in terms of the involvements of dominant / non-dominant lobes, and no differences were found between the patients with dominant and non-dominant lobe involvement as regards the prognostic evaluation ( $p > 0.05$ ).

## DISCUSSION

Stroke is an important health problem causing both psychological and economical undertakings on the patients and relatives. The purpose of the rehabilitation of the patients with acute stroke is to

**Graphic 1. The results of European Stroke Scale (ESS), Allen Prognostic Scale (APS), and Barthel Index (BI).**



1<sup>st</sup> Assessment: The results of assessment at hospital admission (1<sup>st</sup> - 3<sup>rd</sup> day)

2<sup>nd</sup> Assessment: The results of assessment at discharge from hospital (15<sup>th</sup> - 30<sup>th</sup> day)

3<sup>rd</sup> Assessment: The results of assessment at 3 months after discharge

4<sup>th</sup> Assessment: The results of assessment at 6 months after discharge

**Table 2. Comparison of European Stroke Scale and Barthel Index scores.**

	European Stroke Scale Mean±SD	Barthel Index Mean±SD	Z*	p
1 <sup>st</sup> Assessment	53.54±28.88	36.45±32.45	4.12	0.000†
2 <sup>nd</sup> Assessment	56.33±26.90	41.66±31.81	3.42	0.001†
3 <sup>rd</sup> Assessment	76.66±20.44	72.29±22.69	1.96	0.050
4 <sup>th</sup> Assessment	82.00±19.54	81.04±22.21	0.31	0.758

\*: Wilcoxon Signed Ranks Test. † p<0.05.

**Table 3. Comparison of Allen Prognostic Scale and Barthel Index.**

	Allen Prognostic Scale Mean±SD	Barthel Index Mean±SD	Z*	p
1 <sup>st</sup> Assessment	55.75±45.25	36.45±32.45	2.37	0.02 †
2 <sup>nd</sup> Assessment	57.08±43.79	41.66±31.81	1.71	0.09
3 <sup>rd</sup> Assessment	75.16±35.88	72.29±22.69	0.65	0.51
4 <sup>th</sup> Assessment	75.91±34.76	81.04±22.21	0.56	0.57

\*: Wilcoxon Signed Ranks Test. † p<0.05.

**Table 4. Correlation of European Stroke Scale (ESS) and Allen Prognostic Scale (APS) scores with Barthel Index (BI) score.**

	1 <sup>st</sup> Assessment	2 <sup>nd</sup> Assessment	3 <sup>rd</sup> Assessment	4 <sup>th</sup> Assessment
	r*	r*	r*	r*
<b>ESS-BI</b>	0.87 †	0.84 †	0.92 †	0.89 †
<b>APS-BI</b>	0.64 †	0.56 †	0.61 †	0.57 †

\*: Pearson correlation coefficient. † p<0.01  
1<sup>st</sup> Assessment: The results of assessment at hospital admission (1<sup>st</sup> - 3<sup>rd</sup> day)  
2<sup>nd</sup> Assessment: The results of assessment at discharge from hospital (15<sup>th</sup> - 30<sup>th</sup> day)  
3<sup>rd</sup> Assessment: The results of assessment at 3 months after discharge  
4<sup>th</sup> Assessment: The results of assessment at 6 months after discharge

**Table 5. Correlation of European Stroke Scale and Allen Prognostic Scale scores with age of patients.**

	Age	
	r*	
<b>European Stroke Scale</b>	1 <sup>st</sup> Assessment	0.28
	2 <sup>nd</sup> Assessment	0.19
	3 <sup>rd</sup> Assessment	0.28
	4 <sup>th</sup> Assessment	0.32
<b>Allen Prognostic Scale</b>	1 <sup>st</sup> Assessment	0.34
	2 <sup>nd</sup> Assessment	0.34
	3 <sup>rd</sup> Assessment	0.49 †
	4 <sup>th</sup> Assessment	0.44 †

\*r: Pearson correlation coefficient. † p<0.05

ensure the highest level of recovery in functional level, walking ability, and self-care, together with re-acquisition of the psychosocial role of the patient. Arranging the rehabilitation programs according to the scale results, which predict the recovery in the acute phase, has a great importance in obtaining this goal<sup>20-24</sup>. Many scales have been developed with this purpose. ESS and APS are among these.

Comparative studies have been performed for comparing ESS with other prognostic scales. In these studies, ESS has been determined to be more sensitive as compared to other scales, and also to predict the prognosis better, since it scores the neurological disorders better<sup>15-17</sup>. However, no studies comparing ESS and APS scales are found.

In our study, which we performed to determine which one of ESS and APS assessments performed in four different times showed the functional improvement better, it was found that APS did not reflect the functionality levels determined with BI in 3<sup>rd</sup> and 6<sup>th</sup> months after stroke, and it was the same for ESS between 1<sup>st</sup> and 30<sup>th</sup> days. This shows that APS predicts the functional levels of patients with stroke better in 1<sup>st</sup> and 30<sup>th</sup> days after stroke, and ESS predicts better after the 3<sup>rd</sup> month after stroke.

When the correlations of ESS and APS with BI are examined, it was found that both methods correlated with BI; however, correlation of ESS was better as compared to APS. It can be suggested that this difference arises from lesser parameters of APS according to ESS, greater similarity of the parameters of ESS to those of BI.

There are many factors influencing the prognoses of patients with stroke, like age, gender, dominant lobe involvement, and localization of the lesion.

Bagg et al performed a study in 2002 in order to investigate the effects of age on the functional statuses of 640 patients with stroke. They advocated that the effect of age only on the functional status was as low as less than 2%; and it could affect the outcome only in combination with other factors.<sup>25</sup>

Inouye also performed a study of 464 patients with stroke in 2001 to investigate whether or not age could be a predictor of stroke rehabilitation, and found that age was an important prognostic factor; however it was unable to affect the

outcome by itself.<sup>26</sup>

In our study, it was seen that a relationship with age was found only in the assessment results of APS in 3<sup>rd</sup> and 6<sup>th</sup> months. This is related to the fact that age is one of the most important factors on the score of the patient with APS. There is a constant value (+40) in APS. The value calculated by multiplying the patient's age with 0.4 is subtracted from +40, and after that a certain amount is also subtracted from this value according to each existing neurological symptom, and APS score is obtained thus. Since the score of APS will decrease with the increasing age, the recovery percentage will decrease also. In addition, if there are no neurological symptoms APS score will be determined by age only.<sup>22</sup> Since a prominent decrease is seen in neurological symptoms occurs in 3<sup>rd</sup> and 6<sup>th</sup> months because recovery in patients with stroke is in the highest level in these period, and also since age can become the most important factor in determining the APS factor, a significant relation in our patients was seen between age and improvement in 3<sup>rd</sup> and 6<sup>th</sup> months. However, in the initial assessments when neurological symptoms were more, it was seen that age was not a factor influencing the recovery level itself.

In our study, it was also examined whether the involvement of dominant / non-dominant lobes affected the prognosis or not, and it was seen that there were no statistically significant differences of the assessment results of ESS and APS.

Nepomuceno et al concluded that involvement of dominant / non-dominant lobes had no effect on the functional status in their study on patients with stroke too.<sup>27</sup>

It was seen in our study that ESS and APS could predict the prognoses of patients with stroke; however, APS could make better predictions after 1<sup>st</sup> – 30<sup>th</sup> days, and ESS could predict better after 3<sup>rd</sup> and 6<sup>th</sup> months. It was also seen that ESS showed better correlation with BI as compared to APS. Comparing these results with others was not possible since there were no other studies in the literature comparing ESS with APS. Apparently, scales have advantages and

disadvantages according to each other. Performing longer-term studies on greater numbers on patients are required for making more decisive conclusions in this issue.

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