8 Journal of Neurological Sciences [Turkish] **34:(2)**# 58; 143-152, 2017
http://www.jns.dergisi.org/text.php3?id=1037
doi: 10.24165/jns.9472.16

Research Article

Factors Affecting Hospital Length of Stay Among Patients With Acute Stroke

Evrim GÖZ[1], Turhan KAHRAMAN[2], Arzu GENÇ[1], Özgecan KAYA[3], Vesile ÖZTÜRK[3], Kürşad KUTLUK[3]

[1]Dokuz Eylül University, School of Physical Therapy and Rehabilitation, İzmir, Turkey [2]İzmir Katip Celebi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İzmir, Turkey [3]Dokuz Eylül University, Faculty of Medicine, Department of Neurology, İzmir, Turkey

Summary

Background: The cost of hospitalization for stroke accounts for a large proportion of the total cost of stroke in the first 12 months. Factors that affect hospital length of stay (LOS) among patients with acute stroke should be understood in order to develop appropriate rehabilitation targets and plan discharge times. The aim of this study was to determine factors that influenced LOS among patients with acute stroke.
Methods: The records of 1507 patients' who were hospitalized due to acute stroke between September 2011 and September 2013 were investigated retrospectively; 909 patients were eligible for the study. Age, sex, stroke types (ischemic or hemorrhagic), muscle strength of upper and lower extremities, number of co-morbidities, presence of infection, physiotherapy information, history of smoking, and LOS were recorded.
Results: The mean length of stay was 7 days (interquartile range: 5-13 days). Patients with hemorrhagic infarct, aphasia, infection, atrial fibrillation, and history of smoking had significantly longer LOS. LOS was also longer when patients received physiotherapy. The presence of infection and functional disability level (assessed using the modified Rankin Scale) emerged as significant predictors for LOS.
Conclusions: Functional disability level and presence of infection may be used to predict the LOS in patients with stroke. In the acute term, realization of infection and detailed assessment of functional disability are fundamental issues.

Key words: Acute, hospitalization, length of stay, stroke

Akut İnme Hastalarında Hastanede Kalış Süresini Etkileyen Etkenler

Özet

Amaç: İnme sonrası 12 ay içerisinde oluşan giderlerin büyük bir çoğunluğunu, hastanede kalış giderleri oluşturmaktadır. Akut inme hastalarında uygun rehabilitasyon amaçlarının belirlenmesi ve taburculuk zamanının tasarlanması için hastanede yatış süresini etkileyen etkenlerin anlaşılması gerekmektedir. Bu çalışmanın amacı, akut inme hastalarında hastanede yatış süresini etkileyen etkenleri belirlemektir.
Yöntem: Eylül 2011-Eylül 2013 tarihleri arasında hastanede yatan 1507 akut inme hastasının kayıtları geriye yönelik incelendi. 909 hasta çalışma için uygun bulundu. Yaş, cinsiyet, inme türü (hemorajik ya da iskemik), kol ve bacak kas kuvveti, eşlik eden hastalık sayısı, enfeksiyon varlığı, fizyoterapi bilgisi, sigara öyküsü ve yatış süresi kaydedildi.
Sonuçlar: Ortanca kalış süresi 7 (çeyrekler aralığı: 5-13) gündü. Hemorajik enfarktı, afazisi, enfeksiyonu, atriyel fibrilasyonu ve sigara kullanımı olan hastalar, anlamlı olarak daha uzun

süre kalmışlardır. Fizyoterapi alan hastaların yatış süresi daha uzundu. Enfeksiyon varlığının ve fonksiyonel dizabilite düzeyinin (Modifiye Rankin Ölçeği ile belirlenmiştir), hastanede yatış süresi için anlamlı göstergeler oldukları anlaşılmıştır.
Tartışma: Akut dönemde, enfeksiyonun belirlenmesi ve fonksiyonel dizabilitenin detaylı değerlendirilmesi temel konulardır. Fonksiyonel dizabilite ve enfeksiyon varlığı ile ilgili bilgiler inme hastalarında hastanede kalış süresini öngörebilmek için kullanılabilir.

Anahtar Kelimeler: Akut, inme, yataklı tedavi, yatış süresi

INTRODUCTION

The World Health Organization defines stroke as "a clinical syndrome, of presumed vascular origin, typified by rapidly developing signs of focal or global disturbance of cerebral functions lasting more than 24 hours or leading to death" (1). It is the fifth most frequent cause of mortality worldwide after heart disease, cancer, chronic lower respiratory disease, and unintentional injuries, and a major cause of disability (2-5). Stroke is a major public health problem and has a significant impact on patients, their families, and society (6).

Stroke recovery starts during the first days and continues for a long time, and stroke care poses an important economic burden (7,8). Treatment in the stroke unit is effective in the acute term (9). A favorable outcome in the acute stage depends on early diagnosis and treatment, therapeutic interventions to prevent stroke recurrence, early rehabilitation, and planned discharge (10). Rehabilitation should be started as early as possible and should be continued as needed. Therefore, rehabilitation assessment in the first 24-48 hours after stroke onset is highly recommended with initiation of rehabilitation as soon as possible (11).

Hospitalization for stroke costs account for a large proportion of the total cost of stroke in the first 12 months (10). Therapeutic interventions are planned with the aim of reducing the hospital length of stay (LOS) in order to minimize the cost of hospitalization after stroke (12). The factors which affect the LOS among acute stroke patients should be understood in order to develop appropriate rehabilitation targets and plan discharge (10).

The average LOS may be predicted by using parameters such as demographic variables, stroke severity, and comorbidities (12,13). Predicting LOS has become increasingly important for individuals, their families, health professionals, hospital administrators, and healthcare systems providing beneficial information about patients' prognosis (8).

To the best of our knowledge, some studies have been conducted in different countries about mortality and morbidity in acute stroke (14). However, there are no studies in Turkey about LOS after stroke. Hence, we aimed to determine factors that affected LOS in patients with acute stroke.

MATERIAL AND METHODS

The study was approved by the Ethics Committee of Dokuz Eylül University (Ethical approval No: 1270-GOA). Medical records of patients with stroke who were hospitalized from September 2011 to September 2013, were extracted from the medical registry database of Dokuz Eylül University Hospital. PROBEL Hospital Information System was used to reach the patients' information and medical records, and they were reviewed retrospectively. Information about age, sex, stroke type (haemorrhagic or ischemic), ischemic stroke subtype (large-artery atherosclerosis, cardioembolism, small-vessel occlusion, stroke of other determined etiology, stroke of undetermined etiology), stroke localization (right hemisphere, left hemisphere, bilateral hemisphere, brain stem and cerebellum), aphasia, length of

stay, number of co-morbidities, physiotherapy information (received or not, duration of physiotherapy), muscle strength (upper and lower extremity), functional disability (modified Rankin Scale-mRS) and stroke risk factors (previous stroke history, hypertension, diabetes mellitus, cardiovascular diseases, atrial fibrillation, dyslipidaemia, obesity, anemia and history of smoking) and tissue plasminogen activator treatment information were recorded. In medical records, it was seen that antithrombotic drugs were used according to the subtypes of ischemic stroke and previous treatment in patients with ischemic stroke; antiplatelet therapy was started after 24 hours in patients who were treated with tissue plasminogen activator (tPA), or in the hyperacute period in the emergency department in patients who were not treated with tPA; anticoagulant therapy was initiated in patients with cardioembolic stroke.

The patients who died during the hospital stay, did not have a definite stroke diagnosis, were transferred from another service because of having a stroke, and those who had incomplete information were excluded from the study.

Statistical Analysis

The data were analyzed using IBM SPSS Statistics (version 20.0). Normality of data distribution was checked using the Kolmogorov-Smirnov/Shapiro-Wilks tests and histograms. The results for characteristics of participants are presented as numbers (percentages) for categorical variables, and median (interquartile ranges) for continuous variables because they were not distributed normally. The Mann-Whitney U test was used to determine the differences of LOS within the groups. Associations between the LOS and other variables were evaluated using Kendall Tau-b and Spearman's rank correlation coefficients. Multiple regression analysis was used to assess the effect of clinical parameters on LOS with a stepwise inclusion model. The level of significance was set at $p<0.05$.

RESULTS

Of the 1507 patients whose records were viewed, 21 died during the hospital stay, 417 did not have a definite stroke diagnosis, 56 were transferred from another service, and 104 had incomplete information. These records were excluded and 909 records in total were evaluated (Figure 1).

The medical records of 909 patients were analyzed. The median age of the patients was 73 years and there were 438 (48.2%) female patients. Eight hundred four patients (88.4%) had an ischemic infarct. The median LOS was 7 days (IQR, 5-13 days). Four hundred four patients received physiotherapy during their hospital stay. The main characteristics of the participants, ischemic infarct subtypes, states of consciousness, types of infection, stroke risk factors, and mRS scores are presented in Table 1.

Table 2 presents the differences in LOS by characteristics. Patients with a hemorrhagic infarct had significantly longer LOS ($p<0.001$). Patients who had an aphasia, infection or atrial fibrillation had significantly longer LOS ($p<0.05$). Length of stay was significantly different in patients with and without history of smoking ($p<0.001$), and was longer when patients received physiotherapy ($p<0.001$). There was no significant difference between male and female patients ($p>0.05$). Patients aged <65 years and >65 years did not have significantly different LOS ($p>0.05$). There were too few patients with obesity and anemia to compare in terms of LOS.

There were significant positive correlations between LOS and type of infarct, number of comorbidities, history of smoking, presence of atrial fibrillation, and mRS ($p<0.05$) (Table 3). LOS was negatively correlated with presence of aphasia and infection, muscle strength of upper and

lower extremities, and physiotherapy ($p<0.05$) (Table 3).

Variables correlated with LOS were included in the regression model. Table 4 presents the results of the multiple linear regression used for developing the predictive model for LOS. When these variables were modeled together, the presence of infection and mRS score emerged as significant predictors. If a patient had an infection or low mRS score, the LOS increased. These variables explained 24% of the variability in the LOS ($p<0.001$).

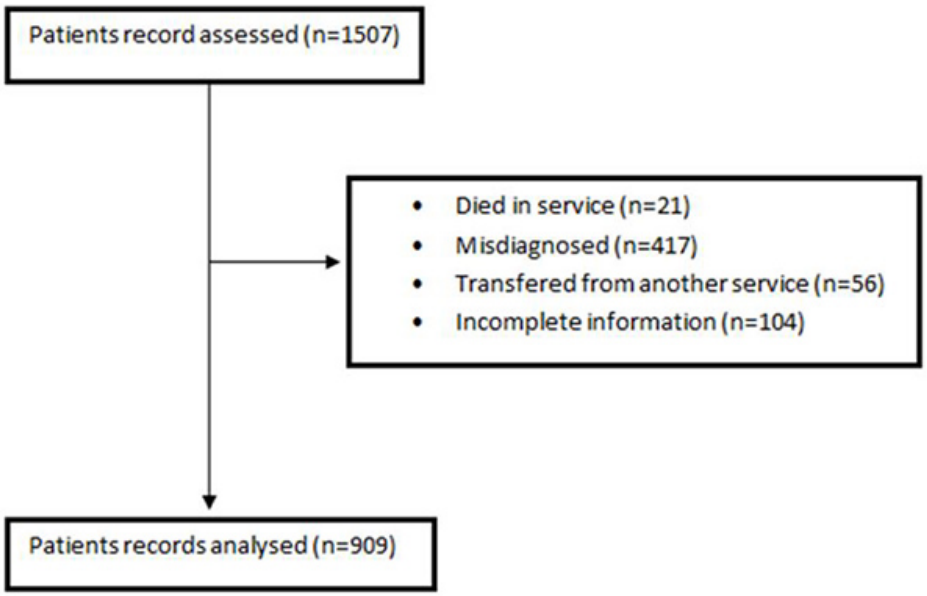

Figure 1: *Flowchart of study process*

Table 1. Characteristics of the participants (N = 909)

Variables	Number (%) or median (IQR)
Sex (female)	438 (48.2%)
Age (years)	73 (63 – 82)
Type of infarct (ischemic)	804 (88.4%)
Types of ischemic infarct	
Large-artery atherosclerosis	273 (30.0%)
Cardioembolism	230 (25.3%)
Small-vessel occlusion	178 (19.6%)
Stroke of other determined etiology	89 (9.8%)
Stroke of undetermined etiology	139 (15.3%)
State of consciousness	
Conscious	826 (90.9%)
Tends to sleep	73 (8.0%)
Unconscious	10 (1.1%)
Presence of tPA therapy	88 (7.5%)
Presence of aphasia	152 (16.7%)
Presence of infection	141 (15.5%)
Types of infection	
Unspecified	53 (5.8%)
Urinary tract infection	27 (3.0%)
Systemic infection	11 (1.2%)
Pneumonia	47 (5.2%)
Upper respiratory infection	4 (0.4%)
Soft tissue infection	3 (0.3%)
Number of comorbidities	2 (1 – 3)
Presence of previous stroke history	161 (17.7%)
Presence of hypertension	588 (64.7%)
Presence of diabetes mellitus	275 (30.3%)
Presence of cardiovascular disease	267 (29.4%)
Presence of atrial fibrillation	116 (12.8%)
Presence of dyslipidemia	110 (12.1%)
Presence of obesity	7 (0.8%)
Presence of anemia	3 (0.3%)
Presence of smoking history	174 (19.1%)
Modified Rankin Scale	2 (2 – 4)
Muscle strength of upper extremity	4/5 (3/5 – 5-/5)
Muscle strength of lower extremity	4/5 (3/5 – 5-/5)
Received physiotherapy	404 (44.4%)
Length of stay (days)	7 (5 – 13)

IQR: Interquartile range, tPA: Tissue plasminogen activator

Table 2. Comparison of the length of stay based on the patient characteristics

	Length of stay (days)	p
Gender		
Female	8 (5 – 15)	0.052
Male	7 (5 – 11)	
Age		
<65 years	8 (5 – 12)	0.490
≥65 years	7 (5 – 7)	
Type of infarct		
Ischemic	7 (5 – 12)	<0.001*
Haemorrhagic	10 (6 – 18)	
Presence of tPA therapy		
Yes	8 (5 – 17)	0.122
No	7 (5 – 13)	
Presence of aphasia		
Yes	9 (6 – 14.75)	0.001*
No	7 (5 – 13)	
Presence of infection		
Yes	17 (11 – 27)	<0.001*
No	7 (4 – 10)	
Presence of previous stroke history		
Yes	8 (5 – 13)	0.384
No	7 (5 – 13)	
Presence of hypertension		
Yes	7 (5 – 13)	0.681
No	8 (5 – 13)	
Presence of diabetes mellitus		
Yes	8 (5 – 13)	0.395
No	7 (5 – 13)	
Presence of cardiovascular disease		
Yes	8 (5 – 13)	0.536
No	7 (5 – 13)	
Presence of atrial fibrillation		
Yes	9 (6 – 15)	0.003*
No	7 (5 – 13)	
Presence of dyslipidaemia		
Yes	6 (4.75 – 11)	0.118
No	8 (5 – 13)	
Presence of obesity		
Yes	8 (7 – 11)	0.875
No	7 (5 – 13)	
Presence of anaemia		
Yes	6 (5 – 6)	0.987
No	7 (5 – 13)	
Presence of smoking history		
Yes	6 (4 – 10.25)	<0.001*
No	8 (5 – 13)	
Received physiotherapy		
Yes	9 (6 – 15.75)	<0.001*
No	6 (4 – 10)	

* Significantly different at the 0.01 level.
tPA: Tissue plasminogen activator

Table 3. Correlations between length of stay and the other variables in the stepwise multiple regression analysis

Variables*	Length of stay
Type of infarct (ischemic / haemorrhagic)	0.138 [a]
Presence of aphasia (yes / no)	- 0.092 [a]
Presence of infection (yes / no)	- 0.360 [a]
Number of comorbidities	0.068 [b]
History of tobacco use (yes / no)	0.099 [a]
Presence of previous stroke history (yes / no)	0.024
Presence of hypertension (yes / no)	- 0.011
Presence of diabetes mellitus (yes / no)	0.024
Presence of cardiovascular disease (yes / no)	0.017
Presence of atrial fibrillation (yes / no)	0.082 [a]
Presence of dyslipidemia (yes / no)	- 0.052
Modified Rankin Scale	0.365 [a]
Muscle strength of upper extremity	- 0.278 [a]
Muscle strength of lower extremity	- 0.291 [a]
Received physiotherapy (yes / no)	- 0.281 [a]

[*] Kendall Tau-b and Spearman's rank correlation; coefficients are presented for dichotomous and continuous variables, respectively.
[a] Correlation significant at the 0.01 level. [b] Correlation significant at the 0.05 level.

Table 4. Multiple stepwise linear regression analysis with length of stay as the dependent variable to determine the significance of the model

Predictor variables	Unstandardized Coefficients	Standardized Coefficients (β)	Adjusted R^2	F	p
Presence of infection	– 14.557	– 0.448	0.200	227.026	< 0.001*
Modified Rankin Scale	– 11.871	– 0.365	0.246	148.825	< 0.001*

DISCUSSION

Predicting LOS in stroke is complicated for healthcare professionals. We investigated factors that affect LOS in acute stroke. Patients with hemorrhagic infarctions, aphasia, infection and smoking history had longer LOS. Additionally, we found that infection and muscle strength of the upper extremities were the strongest predictors for LOS.

Patients with stroke are heterogeneous in terms of infarct type and the consequences of stroke (8). Infarct type has been shown to be predictive of LOS in some studies. It was found that type of infarct influenced LOS in a Chinese study (15). In another study, patients who had hemorrhagic stroke stayed longer in hospital than those ischemic stroke (13). Similarly, in our study, patients with hemorrhagic stroke had longer LOS.

Hospital complications are common in patients with hemorrhagic and ischemic stroke, and are also associated with longer LOS in the acute stage. Previous studies about LOS have especially centered on infections, evidence is limited with other medical complications (16-18). Ingeman et al. found that patients hospitalized with medical complications had longer LOS than patients without complications. Moreover, infections, particularly pneumonia, were associated with increased 30-day and 1-year mortality (19). Likewise, we found that the patients who had an infection had significantly longer LOS. Length of stay could be decreased by preventing complications such as infection (20).

Smoking is another predictor of extended LOS, in addition to infection, and has been shown in most studies (20-23). A Taiwanese study found that patients without a history of smoking had decreased LOS (23). In contrast, smokers stayed 4 days longer than non-smokers in a Swedish study (24). In our study, patients with a history of smoking stayed for less time than non-smokers.

The influence of sex on LOS after stroke is still unclear (25). Female patients tend to stay longer in hospital than male patients (10,13,24,26). It was found in an Australian study of over 6000 patients with stroke that LOS was longer for females (10). Contrary to this, a Taiwanese study showed that male sex could be used to predict LOS (25). The researchers claimed that female patients were older than male patients so they stayed longer in hospital, but there was no significant difference between male and female patients in terms of age and LOS. The higher presence of infection, numbers of comorbidities, decreased upper and lower extremity muscle strength are considered possible reasons for the longer LOS in females in our study.

Aphasia is another important consequence of stroke like muscle weakness. Some researchers found that aphasia was a predictor for LOS like in our study (27). If aphasia is persistent after the first months, it may negatively affect activities of daily life and it might increase hospital LOS for patients.

Atrial fibrillation is one of the risk factors of stroke. In previous studies, some researchers found that atrial fibrillation was a predictive factor in LOS (20,28). Additionally, these studies showed that patients with a history of atrial fibrillation incurred significantly higher costs because of hospitalization (28). Similar to these studies, we found that patients with stroke who had atrial fibrillation stayed longer than those who had no atrial fibrillation.

The longer LOS among patients with stroke has been associated with more severe disability, which is a consequence of poor muscle strength caused by stroke (10,28). According to our study, patients, who had greater functional disability and received physiotherapy, stayed longer in hospital. Parallel to our findings, LOS was associated with receiving physiotherapy in

some studies (13). Patients whose muscles are weak have poor functional outcomes so they fail to function properly in their daily lives and depend on others. Additionally, they receive physiotherapy and stay in hospital for a longer time. On the other hand, poor participation in physiotherapy results in lower improvement in functional outcomes and longer LOS. Combining acute care and physiotherapy in a stroke unit may improve patients' functional outcomes and affect their disability levels, which may also reduce the length of hospital stay. Unfortunately, there are too few stroke rehabilitation units for acute and sub-acute patients; consequently, neurologists think that patients should stay longer in hospital and have physiotherapy for a longer period. Our study demonstrates that inpatient rehabilitation units are essential for better outcomes and decreasing LOS in acute stroke units.

This is a single center study and the results show the conditions of only one hospital. This is the greatest limitation of our study. Secondly, due to the retrospective nature of our study, we could not avoid underestimating some medical information. Lastly, the medical records showed that many patients in this study did not have a definite stroke diagnosis.

In conclusion, this study showed that muscle strength and presence of infection might predict LOS in patients with stroke. In acute term, diagnosis of infection and detailed assessment of muscle strength are the fundamental issues.

Correspondence to:
Arzu GENÇ
E-mail: arzu.genc@deu.edu.tr

Received by: 07 April 2016
Revised by: 13 December 2016
Accepted: 20 December 2016

The Online Journal of Neurological Sciences (Turkish) 1984-2017
This e-journal is run by Ege University Faculty of Medicine,
Dept. of Neurological Surgery, Bornova, Izmir-35100TR
as part of the Ege Neurological Surgery World Wide Web service.
Comments and feedback:
E-mail: editor@jns.dergisi.org
URL: http://www.jns.dergisi.org
Journal of Neurological Sciences (Turkish)
Abbr: J. Neurol. Sci.[Turk]
ISSNe 1302-1664

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