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Can the Montreal Cognitive Assessment Predict Discharge Destination in a Stroke Population in the Hospital?

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Background: To decide on an appropriate discharge destination for stroke survivors from hospital, factors such as activities of daily living and age are often taken into account as predictors. Cognition has been found to support the decision whether to send a patient home or to a dependent living situation. The Montreal Cognitive Assessment (MOCA) has been proven to be a suitable cognitive screening instrument in the acute phase after stroke. However, its predictive value in the determination of discharge destination is unknown. The aim of the present study was to examine whether cognitive functioning, as measured with the MOCA, in the acute phase after stroke could predict discharge destination. *Methods:* The study involved 211 patients with a first-ever cerebral stroke within the first week after stroke. Demographic and stroke-specific data, cognitive functioning (MOCA), and level of functional disability (Barthel Index [BI]) were collected. Multivariate logistic regression analyses were used to predict discharge destination (dependent versus independent living situation). *Results:* Both age ($B = -.05$; $P < .01$) and BI score ($B = .33$; $P < .001$) were found to be significantly related to discharge destination with explained variance of 43%. Adding MOCA score as a predictor variable to the model resulted in a nonsignificant improvement of the model, explaining 44% of the variance. *Conclusions:* Cognitive functioning, as measured by a single screening instrument such as the MOCA, in the acute phase after stroke is not predictive for discharge destination. **Key Words:** Stroke—cognitive screening—stroke assessment—neuropsychology.

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Stroke is a major cause of disability. In addition to physical impairment, approximately 50%-78% of stroke patients experience cognitive impairments.[1-3] The most frequently reported cognitive impairments involve problems in memory, orientation, language, attention, executive functioning, and arithmetic and slowness of information processing.[1-4] These "invisible" stroke sequels can have far-reaching consequences for patients and their environment with respect to daily life activities, social activities,[5] sense of well-being,[6] and return to work.[7] Because of the frequency and impact of cognitive impairments, standardized cognitive assessment should be conducted within the first weeks after stroke. Taking into account that (extensive) neuropsychological testing is time-consuming, screening procedures involving all

cognitive domains with sufficient sensitivity and easy to use are called for.

To decide on an appropriate discharge destination from hospital, several factors are taken into account, such as dependence in activities of daily living (ADL) and age.[8] Another important factor that contributes to the discharge destination decision is cognitive functioning, as measured by a neuropsychological examination.[9] Van der Zwaluw et al (2010) found that cognitive screening, including the Mini-Mental State Examination (MMSE), Cognitive Screening Test, and Clock Drawing Test, in the acute phase after stroke contributes to the prediction of a suitable discharge destination. However, the MMSE alone was not a significant predictor for discharge destination and was thus not suitable for prediction. This may be because of the fact that the MMSE does not cover all cognitive domains and was originally developed for dementia screening.[9,10] Hence, the MMSE does not appear to be the optimal means to examine cognitive function and predict outcome in the acute phase after stroke.

The Montreal Cognitive Assessment (MOCA) may be considered a more suitable alternative. This screening instrument is found to be feasible in screening for cognitive impairment in stroke patients[11]; the MOCA corrects for education[12]; the MOCA is more sensitive than the MMSE in screening for cognitive deficits[10,13-15]; and it has a higher internal reliability and less of a ceiling effect than the MMSE.[15] More importantly, the MOCA is superior to the MMSE in screening for cognitive problems in executive functioning, attention, recall, and visual construction.[10] Nonetheless, the predictive value of the MOCA has not yet been investigated.

The aim of the present study, therefore, was to examine to what extent cognitive functioning as measured by the MOCA, administered within 1 week after stroke, is able to predict discharge destination. Because of the fact that functional disability and age influences long-term independence in ADL,[8,16] these factors were taken into the account as well.

Methods

Patients

Stroke patients who were referred to the stroke unit of a hospital in the south of the Netherlands between February 2010 and September 2011 were eligible for participation in the study. Only those patients who were present at the stroke unit on Tuesdays when standardized cognitive screening was conducted were included in the present study. Stroke patients meeting the following criteria were included in the present study: a first-ever stroke, based on the medical record, age 40 years or older (to avoid atypical stroke), eligible for testing (ie, no severe aphasia, impaired consciousness, extreme fatigue, or motor problems based on clinical judgment). Patients who were not able to speak the Dutch language were excluded. The study was conducted according to the Code of Conduct for Medical Research of the Council of the Dutch Federation of Medical Scientific Societies. At this hospital, all patients are informed that their files can be used anonymously for research purposes, unless they object. A review procedure by a medical ethics committee is not needed for use of anonymous routinely collected data.

Procedure

Each patient was screened at the stroke unit (at bedside) by a neuropsychologist using the MOCA within a week after admission to the hospital as part of the standard diagnostic procedure. Four days after admission to the hospital, a nurse established the level of functional disability using the Barthel Index (BI). Demographic and injury-related information was obtained from the patients' medical record (including age, gender, level of education, type of stroke, and date of admission). The multidisciplinary stroke team, consisting of a neurologist, physiotherapist, occupational therapist, speech therapist, nurse, and if the patient was vigorous and younger than 65 years, a rehabilitation doctor, determined a suitable discharge destination for each patient.

Measures

The neuropsychological screening consisted of the MOCA, which can identify mild cognitive impairments in stroke survivors in the acute phase after stroke.[17] It assesses various cognitive functions, including memory, visuospatial ability, executive functioning, attention, concentration, language, and orientation. The MOCA can be administered in 10 minutes. Participants are given 1 additional point if they had less than 12 years of education. The maximum score is 30 points. If an individual achieves a score of less than 26 points, the individual is considered to be cognitively impaired.

The BI score was used to measure the level of functional disability by indicating the ability to perform certain activities in daily life (eg, dressing, external care, and going up and down stairs).[18] The BI consists of 10 items, with a maximum score of 20, implying complete independence. The minimum score is 0, indicating that a patient is totally dependent.

Discharge destination was determined by a multidisciplinary team.

Statistical Analyses

Patient and test characteristics were described on the basis of descriptive statistics.

To investigate whether cognitive functioning in the acute phase after stroke could be used to predict discharge destination, a similar method was used as in van der Zwaluw et al (2010). We dichotomized discharge destination

Table 1. *Patient characteristics*

Characteristics	All patients (n = 211)	Independent discharge destination (n = 68)	Dependent discharge destination (n = 143)
Sex, M/F, n	110/101	40/28	70/73
Age, y, mean ± SD (range)	70.6 ± 11.8 (41-92)	66.0 ± 10.7 (45-85)	72.8 ± 11.6 (41-92)*
Education			
Low/medium/high	23/98/42	4/33/15	19/65/27
Stroke type			
Ischemic/hemorrhagic	184/21	63/2	121/19*
Days between stroke and cognitive screening	5.1 ± 4.9 (1-36)	4.3 ± 3.1 (1-19)	5.5 ± 5.6 (1-36)
MOCA score, mean ± SD (range)	19.8 ± 6.2 (3-30)	23.1 ± 4.5 (7-30)	18.3 ± 6.2 (3-29)*
BI score 4 days after admission, mean ± SD (range)	15.0 ± 5.6 (0-20)	18.7 ± 2.6 (10-20)	13.2 ± 5.7 (0-20)*

Abbreviations: BI, Barthel Index; F, female; M, male; MOCA, Montreal Cognitive Assessment; SD, standard deviation.
*Mean values that are marked with an asterisk indicate a significant difference ($P < .05$) between the independent and dependent group.

into 1 (home; independent, including all patients returning to their homes, not needing any care) and 0 (dependent, including patients who were discharged home with an outpatient rehabilitation facility, plus all patients who were discharged to a destination outside the home, such as a rehabilitation center or nursing home) to create 2 groups that could be compared. Normality was checked and subsequently Mann–Whitney *U* tests were used as an alternative for independent sample *t* tests to determine whether there were differences between the independent and dependent discharge destination groups. When significant differences between groups were found, these factors were controlled for by adding them in the multivariate logistic regression analysis. Pearson correlation coefficients were calculated to determine the associations between demographic variables (including sex, age, education level, type of stroke, days between stroke and screening, and discharge destination) and the screening tests (including MOCA score and BI score). Sequential multivariate logistic regression analysis was run with MOCA score, age and BI score serving as predictor variable s (ie, independent variables) and discharge destination (dependent and independent) as the outcome variable (ie, dependent variable). Two models were analyzed: the first model included age and BI score, as these factors influence the discharge decision process.[8,16] The second model included age and BI score, as well as MOCA score. This model was used to identify the additional predictive value of the MOCA. Variables showing group differences were also added in the analyses. The α level was set at P less than .05. Statistical analyses were performed with the Statistical Package for Social Sciences SPSS, version 17.0 (IBM SPSS 17.0, SPSS Inc., Chicago, IL).

Results

Patients

A total of 392 patients, who were referred to the stroke unit of the Catharina Hospital between February 2010 and September 2011 and who were present on Tuesdays, were considered for a cognitive screening.

Twenty-seven patients passed away before the cognitive screening was conducted. Excluding patients who were aged 40 years or younger (n = 2), and patients who were not (n = 76) or not completely (n = 37) eligible for screening on the basis of the inclusion criteria, resulted in a sample of 250 patients. Patients who were not able to speak the Dutch language and those who refused to cooperate were not included in the study (n = 5). As 32 patients had an unknown BI score and 2 patients had an unknown discharge destination, this resulted in a final study sample of 211 patients who were included in this study. Table 1 describes the patient characteristics.

Patients with a dependent discharge destination were significantly older (U = 3178.50, $P < .001$), required more help with ADL as determined by the BI scores (U = 1819.00, $P < .001$), had lower MOCA scores (U = 2627.50, $P < .001$), and were more likely to have a hemorrhagic stroke (U = 4072.50, $P < .05$) compared with patients who were discharged to an independent destination.

When a MOCA score cutoff value of less than 26 was applied, 47 patients (69.1%) with an independent discharge destination and 124 patients (86.7%) with a dependent discharge destination were classified as cognitively impaired (Table 2). This resulted in a total number of 171 patients (81.0%) being classified as cognitively impaired.

Correlations

Table 3 shows that older patients had significantly lower MOCA scores (r = −.37; $P < .001$), as well as patients with a low educational level (r = .29; $P < .001$), patients with a hemorrhagic stroke (r = .18; $P < .05$), and patients with a low BI score (r = .47; $P < .001$). The more days between the stroke and administration of the MOCA, the lower the MOCA score (r = −.24; $P < .01$).

Table 2. *Number of cognitively impaired and unimpaired patients*

Cognitively impaired/unimpaired	All patients (n = 211)	Independent discharge destination (n = 68)	Dependent discharge destination (n = 143)
Number of cognitively impaired patients (%)	171 (81.0)	47 (69.1)	124 (86.7)
Number of cognitively unimpaired patients (%)	40 (19.0)	21 (30.9)	19 (13.3)

Patients with a higher MOCA score were more likely to be discharged to an independent destination (r = .37; $P < .001$). The significant correlation between education and sex (r = −.18; $P < .05$) indicates that male patients tended to have a higher educational level. Age and BI correlated significantly (r = −.17; $P < .05$), as well as age and discharge destination (r = −.27; $P < .001$), meaning that younger patients had higher BI scores and an independent discharge destination. Patients with a higher educational level had significantly higher BI scores (r = .20; $P < .05$). Patients with an ischemic stroke (r = .16; $P < .05$) and patients with higher BI scores (r = .46; $P < .001$) were more likely to be discharged home.

Logistic Regression Analyses

Because of the finding that both groups differed with respect to type of stroke, this factor was controlled for by adding it as a predictor variable in the logistic regression analyses.

The model including age, BI score, and type of stroke showed good model fit ($\chi^2(3) = 74.2$; $P < .001$; Table 4). According to Nagelkerke's R^2, 43% of the variability was explained by this model. Both age (B = −.05; $P < .01$) and BI score (B = .33; $P < .001$) were found to be significantly related to discharge destination; patients with a lower age and patients with a higher BI score were more likely to be discharged home. However, type of stroke did not significantly contribute in the prediction of discharge destination.

Adding MOCA score as a predictor variable to the model resulted in a nonsignificant improvement of the model ($\chi^2(4) = 76.3$; $P > .05$). MOCA score, combined with the variables age, BI score, and type of stroke explained 44% of the variance. However, although age (B = −.04; $P < .05$) and BI score (B = .31; $P < .001$) were found to be significant predictors of discharge destination, type of stroke and MOCA score were not.

Discussion

From the results of this study it can be concluded that the MOCA does not contribute to the prediction of discharge destination of stroke patients in the first week after stroke.

Age and physical disability contributed to the prediction of discharge destination, which was also found in previous studies.[1,8,16] Although we found that cognition as measured by the MOCA was not predictive for discharge destination, van der Zwaluw et al (2010) showed that a cognitive screening in the acute phase after stroke does contribute to the discharge destination process. Although this contribution was rather small, the difference between the present study and the study of van der Zwaluw et al (2010) can be explained by the fact that van der Zwaluw et al (2010) applied a combination of the MMSE, Cognitive Screening Test, and Clock Drawing Test to measure cognition, whereas we used the MOCA, a single screening instrument. However, both studies show that a particular cognitive screening, such as the MOCA or the MMSE, was not predictive for discharge destination. From this, we can conclude that cognition, measured by a single cognitive screening in the acute phase after stroke is not a suitable

Table 3. *Correlations between the MOCA and demographic and stroke-related characteristics*

Variables	MOCA score	Sex	Age	Education	Type of stroke	Days between stroke and screening	BI score
MOCA score							
Sex	−.03						
Age, y	−.37***	.12					
Education	.29***	−.18*	−.10				
Type of stroke	.18*	−.03	−.01	.07			
Days between stroke and screening	−.24**	−.04	−.04	−.05	.11		
BI score	.47***	−.02	−.17*	.20*	−.13	−.12	
Discharge destination	.37***	−.09	−.27***	.11	−.16*	−.12	.46***

Abbreviations: BI, Barthel Index; MOCA, Montreal Cognitive Assessment.
*$P < .05$, **$P < .01$, ***$P < .001$.

Table 4. *Results from logistic regression analysis*

Regression Models	χ^2	Df	Nagelkerke's R^2	B
Model 1	74.2	3	.43	
Age, y				−.05**
BI score				.33***
Type of stroke				−1.50
Model 2	76.3	4	.44	
Age, y				−.04*
BI score				.31***
Type of stroke				−1.42
MOCA score				.06

Abbreviations: BI, Barthel Index; MOCA, Montreal Cognitive Assessment.
*$P < .05$, **$P < .01$, ***$P < .001$.

manner to predict discharge destination. This may be because of the fact that the MMSE and the MOCA both do not cover all cognitive domains, such as processing speed,[19] which is frequently affected in stroke patients (Rasquin et al, 2004).[20] Future studies should investigate the predictive value of a single cognitive screening, measuring all relevant cognitive domains for long-term outcome in the prediction of discharge destination.

We found that 81% of the stroke patients were cognitively impaired: 69% of the patients with an independent discharge destination and 87% of the patients with a dependent discharge destination. The number of cognitively impaired patients in our study is rather large, compared with earlier studies,[11,19] demonstrating that 65%-66% of the stroke patients were found to have a score below the cutoff value on the MOCA. However, in the studies of Cumming et al (2011) and Pendlebury et al (2012) the patients were screened 3 and 6 months after stroke, respectively, whereas the patients in the present study were screened within 1 week after stroke. As many stroke survivors show considerable recovery over the succeeding months,[21-23] it is conceivable that the patients in the studies of Cumming et al (2011) and Pendlebury et al (2012) were in a further phase of recovery. However, other studies showed that 35%-55% of the patients in the acute phase after stroke were cognitively impaired,[1,8] confirming that the number of cognitively impaired patients in our study is large. As the latter studies did not apply the MOCA, this finding may be explained by the fact that the MOCA is very sensitive in screening for cognitive deficits.

The dependent and independent discharge destination groups differed with respect to age and BI score, which corresponds to previous studies.[1,8] However, both groups also differed in type of stroke, which contradicts the finding in the study of van der Zwaluw et al (2010). Patients with a hemorrhagic lesion were found to score lower on a functional independence measure on admission compared with patients with an ischemic lesion.[24] As the present study showed, functional outcome in stroke patients is an important predictor for discharge destination. This is in line with the finding that the number of patients with a hemorrhagic lesion is proportionally larger in the dependent group.

In clinical practice, other factors than cognition are taken into account when deciding on discharge destination. Living status (ie, dependent or independent, presence of a caregiver, marital status, and membership of societies and clubs) before the incidence of a stroke seems to be an important predictor for discharge destination.[25-29] We did not take these factors into account, which is a limitation of the present study. Moreover, a large proportion of the variability was not accounted for which indicates the possible influence of other factors. Future studies should investigate the predictive value of living status before the incidence of a stroke by adding these variables into the analysis.

Conclusion

Cognition, as measured by a single screening instrument such as the MOCA, is not predictive for discharge destination. On the one hand, future studies should investigate the predictive value of cognition using a more comprehensive screening tool when deciding about a suitable discharge destination. On the other hand, the predictive value of living situation before a stroke should be investigated more extensively when deciding whether a patient should be discharged to their home or to a dependent living situation.

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