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Research Article

Short-Term Outcome in Stroke Patients with or without Atrial Fibrillation: A Retrospective Case-Control Study

Antonino Sant'Angelo,[1] Sergio Bagnato,[1] Cristina Boccagni,[1] Vincenzo Guardabasso,[2] and Giuseppe Galardi[1]

[1] *Rehabilitation Department, Fondazione Istituto "San Raffaele-G. Giglio", 90015 Cefalù (PA), Italy*
[2] *Azienda Policlinico-Vittorio Emanuele, University of Catania, 95123 Catania, Italy*

Correspondence should be addressed to Antonino Sant'Angelo, antonino.santangelo@hsrgiglio.it

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Background. Patients with cardioembolic stroke due to atrial fibrillation (CE/AF stroke) seem to have a poorer functional recovery than those with non cardioembolic stroke. This may be ascribed to the heterogeneity between the samples of patients with and without CE/AF stroke. *Aim.* To compare the short-term outcome of patients with CE/AF stroke and with non-CE/AF stroke of same gender and similar age and level of disability and comorbidity. *Methods.* The functional independence measure (FIM) of 40 consecutive patients with CE/AF stroke was retrospectively evaluated at admission and discharge in our rehabilitation department. Each "case" was matched with a patient ("control") of the same sex and similar age and FIM score at admission, affected by non-CE/AF stroke admitted to our department in the same period. *Results.* FIM score at admission and discharge was respectively 51.9 ± 20.3 and 75.7 ± 21.2 in patients with CE/AF stroke and 54.9 ± 19 and 73.9 ± 22.7 in patients with non-CE/AF stroke; no significant difference was found between the groups. Multivariate analysis showed an effect of the rehabilitation treatment and age on FIM score, whereas no effect was attributable to AF. *Conclusions.* The short-term outcome is similar in patients with and without CE/AF stroke.

1. Introduction

Cardioembolic (CE) strokes account for 25 to 30% of ischemic strokes among white populations [1], most of which are associated with atrial fibrillation (AF). In fact AF is the most common persistent cardiac arrhythmia [2], and its prevalence has been estimated at 1% in the general population [3, 4], ranging from about 1% in people aged between 55 and 59 years to 9–13% in people older than 80 years [4–6].

Previous studies have reported that CE stroke associated with AF (CE/AF stroke) has a poorer prognosis in terms of survival because of the higher risk of early stroke recurrence, the larger volume of the infarct, the existing cardiac disease causing the arrhythmia, and the older age of patients compared to those with other ischemic strokes [7–9]. It has been also reported that patients with CE/AF stroke display a worse functional recovery than those with non-CE/AF stroke [7]. However, such a finding was drawn from the comparison of heterogeneous samples of patients. Hence, it has not been conclusively established the functional outcome of patients with CE/AF stroke. The aim of our study was to compare the short-term outcome of patients with or without CE/AF stroke after removing some confounding factors, such as different sex, age, and level of disability. Therefore, we used the Functional Independence Measure (FIM) instrument [10] in a retrospective case-control study to compare the short-term outcome of patients with a CE/AF stroke matched with non-CE/AF stroke patients of same sex and similar age and level of disability.

2. Materials and Methods

This retrospective case-control study was conducted on clinical records of patients admitted to our Rehabilitation department from January 2005 to June 2009 to carry out

a standard neurorehabilitative treatment after an ischemic stroke.

We selected the clinical records of 40 patients ("cases"; 23 males, mean age 65.4 ± 9.1 years) with CE/AF stroke as supported by a 12-lead electrocardiogram (ECG) or Holter-ECG recorded during the acute phase. CE/AF stroke was diagnosed according to focal neurological symptoms and signs, with neuroradiological brain evidence of infarction associated with AF as the cardiac source of embolism, without evidence of large-artery disease by noninvasive vascular testing. The clinical record of each "case" was matched with that of a patient ("control") affected by non-CE/AF ischemic stroke (40 "controls"; 23 males, mean age 65.5 ± 8.9 years) with the same sex and similar age, level of disability and duration of disease.

Mean disease duration (DD) was expressed as the time interval (days) from stroke onset to admission to our department. Both groups had a similar length of hospitalization (LOH) and carried out the same standard rehabilitative treatment, consisting of 2 hours per day of kinesitherapy and occupational therapy, added to regular bed mobilization, chair transfers, and, when required, speech therapy and cognitive rehabilitation. During their stay in rehabilitation department the patients' physical burden of illness was measured by the severity index (SI) and comorbidity index (CI) of the Cumulative Illness Rating score (CIRS) [11]. The CIRS is a valid indicator of health status and a comprehensive comorbidity index among frail people [12]. CIRS uses a 5-point ordinal scales (score 1–5) to estimate the severity of pathology in each of 14 systems domains. Based on the ratings, two scores are derived: the SI (it is the mean of the scores of the first 13 categories, excluding psychiatric; it reflects the overall burden of illness, and it ranges 1–5) and the CI (it is calculated as the number of categories with a score of 3 or greater, excluding psychiatric; it reflects diversity of illnesses and it ranges 0–13).

2.1. Outcome Measure. The functional outcome was evaluated in each patient at admission and at discharge by means of the FIM instrument. It is a scale measuring a person's level of disability in terms of burden of care [13]. It was developed specifically to measure functional outcomes of rehabilitation [14]. FIM is a trademark of the Uniform Data System for Medical Rehabilitation, a division of UB Foundation Activities, Inc.

The FIM at admission and at discharge was administered by the patient's care team, consisting of a neurologist, a nurse, a physiotherapist and a psychologist/speech therapist, all experts and trained in its use. As this is a retrospective study, nobody knew the purpose of the present study at the time of the assessments.

2.2. Statistical Analysis. Descriptive statistics were computed and compared to confirm homogeneity of case and control groups before treatment. Analysis of variance (ANOVA) was used to compare results within patients before/after treatment, considering presence/absence of AF. A two-by-two ANOVA design, between-within subjects, was used. Statistical significance was set at the $P = 0.05$ level. Multiple linear regression was then used to compute the effect of each explanatory factor simultaneously adjusted for the effects of other factors. With this technique, so called confounding factors can be controlled separately. A linear model was construed, where the observed (dependent) variable was FIM. Explanatory factors (regressors) considered were: a numerical variable, *age* at time of hospital admission (expressed in years and tenths of year), and three "dummy" variables: *time* (before/after treatment), *case* (AF/no history of AF), and *sex* (male/female). Multiple linear regression was performed using Epi-info v. 3.5.1 (CDC, Atlanta, USA), suitable for dummy variables and that performs complete ANOVA calculations for significance of individual regressors and interaction terms. Results were expressed as units of FIM explained by each regressor (with 95% confidence intervals, CI). Statistical significance was set at the $P = 0.05$ level.

2.3. Ethics. The protocol was approved by the local Ethics Committee and has been performed in accordance with the ethical standards of Declaration of Helsinki. Data used for the study were those usually recorded in the medical file of patients only.

3. Results

Demographic and clinical characteristics of patients are reported in Table 1. Patients with and without CE/AF stroke were homogeneous regarding mean age, gender, mean disease duration, and mean LOH. Moreover CIRS (SI) and CIRS (CI) did not differ significantly between patients with and without CE/AF stroke. The difference in the level of disability at admission in the Rehabilitation Department and at discharge, as expressed by the FIM score, was not significant between groups (Table 1). ANOVA revealed a significant main effect of the within-subject factor (before/after treatment) (F 155.57; $P < 0.0001$). There were no significant effects either for the between-subjects factor (presence or absence of AF, $P = 0.89$) or for the interaction ($P = 0.16$) (Figure 1).

Multiple linear regression showed that *time* (before/after treatment), as expected, and *age* were significant factors ($P < 0.001$ and $P = 0.014$ resp.) in explaining FIM values, whereas *sex* was almost statistically significant ($P = 0.086$) and *case* was not a significant explanatory variable ($P = 0.84$). Results (Table 2) indicate the net effects of each variable on FIM values, simultaneously adjusted for all other factors:

(i) *time* caused an average increase of FIM after treatment of 21.35 (CI 15.05 to 27.65);

(ii) *age* explained an average loss of FIM of 4.5 per decade of age (−0.45 per year, CI −0.81 to −0.09), both before and after treatment;

(iii) *sex* explained a level of FIM lower by 5.67 as average in females versus males, with CI −12 to slightly above zero, indicating that this factor did not reach the $P < 0.05$ level of statistical significance ($P = 0.086$);

(iv) *case*, CE/AF stroke patients or matched controls, did not explain any significant difference in FIM average.

Table 1: Demographic and clinical characteristics of patients with (no. 40) and without (no. 40) CE/AF stroke undergoing a standard rehabilitation treatment.

Patients	Gender	Age	Affected hemisphere	DD (days)	LOH (days)	CIRS (SI)	CIRS (CI)	FIM (admission)	FIM (discharge)
CE/AF	23 males	65.4 ± 9.1	Right: 21 patients	32.3 ± 24.4	41.6 ± 13.4	1.1 ± 0.2	5.4 ± 1.4	51.9 ± 20.3	75.7 ± 21.2*
Non-CE/AF	23 males	65.5 ± 8.9	Right: 21 patients	28.9 ± 22.7	42.8 ± 16.1	1.2 ± 0.2	5.3 ± 1.3	54.9 ± 19	73.9 ± 22.7*
		$P = 0.95$		$P = 0.55$	$P = 0.74$	$P = 0.21$	$P = 0.86$	$P = 0.49$	$P = 0.72$

Data are expressed as mean ± SD. DD: disease duration, LOH: length of hospitalization, CIRS (SI): cumulative Illness Rating score (severity index), CIRS (CI): Cumulative Illness Rating score (comorbidity index), FIM: functional independence measures, *significant treatment (time) effect.

Table 2: Results of multiple linear regression.

Factor	Value	95% CI	P
time	21.35	15.05 to 27.65	<0.0001
age	−0.45	−0.81 to −0.09	0.014
sex	−5.67	−12.11 to 0.76	0.086
case	−0.64	−6.94 to 5.65	0.8418

NOTE: intercept was 85.8 (95% CI 62–110); F statistic for regression = 13,72 $P < 0.0001$, R-squared = 0.26.

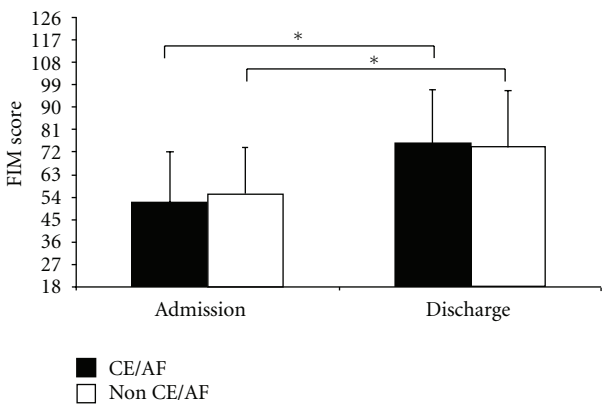

Figure 1: FIM score (means and SD) before and after a standard rehabilitative treatment in patients with (black column) and without (white column) CE/AF stroke. *significant treatment (time) effect.

Possible synergistic effects of factors were considered (case and time, sex and time, and age and time), but no significant interaction between factors was observed.

As it could be expected, the linear model used did not fully explain the individual differences in FIM before and after treatment. Indeed the R-squared value of 0.26 indicated that about 26% of the overall variability was explained. However, it illustrated and quantified the effects of treatment and of age, hinted at a possible systematic difference of FIM by sex, and corroborated the hypothesis that AF *per se* is not a significant factor in recovery.

4. Discussion

The main results of this study were that both groups of stroke patients—with and without CE/AF stroke—had similar FIM scores at admission and at the end of rehabilitative treatment. The similarity of FIM scores at admission reflects their homogeneity in terms of level of disability before the rehabilitative treatment. Moreover the lack of significant differences in CIRS (SI) and CIRS (CI) between the groups suggests an overall homogenous health status and comorbidity level. FIM and CIRS scores, along with the age and gender homogeneity between groups, rule out a bias in the assessment of their functional outcome after rehabilitation. As the improvement of FIM score after a rehabilitative treatment may be considered an index of functional outcome and therapeutic effectiveness, our results indicate that the short-term functional outcome is comparable in patients with CE/AF stroke and in patients with non-CE/AF stroke. Therefore, in a population homogeneous regarding age, gender, and initial level of disability and comorbidity, the presence of AF does not seem to be a significant factor in functional recovery of patients with ischemic stroke receiving inpatient rehabilitation. However, on the basis of the data of the present study, these considerations can be made only for patients with a moderate degree of disability that, in our study, is expressed by the FIM score at the admission of about 52–55 points. These data are consistent with those of Leys et al. [15], who reported that clinical outcome in young adults with ischemic stroke was independent from the cause of stroke.

These results seem to be at odds with other studies, according to which AF would play a negative prognostic role [7–9]. However in these studies patients with CE/AF stroke were mostly females, older, and have poorer prestroke functional status and more severe neurological deficits than patients with other types of ischemic stroke. It is likely that methodological differences may explain these discrepancies. The population-based studies cited above included the whole community of stroke patients, while our case-control study limited its observation to patients admitted for intensive rehabilitation. So, patients (presumably, more with AF) who died during the acute stage of disease or referred to an extensive rehabilitation department because of a more severe clinical state were not included. Similarly, those patients undergoing a rapid recovery from major neurological deficits (so called "spectacular shrinking deficit") due to reperfusion of brain with early lysis of the embolus were not studied.

Another factor that should be taken into account is the temporal window used. Unlike other studies [8], we have not followedup our patients after their discharge; therefore, we cannot exclude any possible effect of AF on the long-term functional outcome for sure. In such cases, as suggested by

others, heart failure, but not the cerebral cardioembolism, is a predictor of dependency 1 year after a first-ever stroke [16].

Finally, the present study, consistently with data reported in literature, confirms that age plays a crucial role as a risk factor for dependency after a first-ever stroke [16]. Particularly, age explains an average loss of FIM of 4.5 per decade both before and after treatment. We should, however, be careful in the interpretation of this result, because our study was not designed to evaluate the effect of age on functional outcome after stroke rehabilitation; therefore, it is difficult to distinguish between age itself and age-associated factors (i.e., comorbidities, and lack of motivation...) as factors influencing the level of functional recovery after a stroke [17].

5. Conclusions

In summary, the short-term functional outcome is comparable in stroke patients with and without AF admitted to the poststroke rehabilitative treatment. Considering the expected ageing of population and the increasing incidence of AF and stroke, it is important to provide timely access to effective stroke rehabilitation programs for all stroke survivors, regardless of stroke pathogenesis.

Conflict of Interest

The authors declare that they have no conflict of interests.

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