Sex Disparity in the Access of Elderly Patients to Acute Stroke Care

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Background and Purpose—Sex differences in the management of acute coronary symptoms are well documented. We sought to determine whether sex disparities exist in acute stroke management, particularly with regard to early hospital admission and thrombolytic therapy.

Methods—We analyzed a prospective, countywide, hospital-based stroke registry. Between 1999 and 2005, all cases with a final diagnosis of cerebral infarction (ICD-10 I63) or intracerebral hemorrhage (ICD-10 I61) were selected. Datasets with missing values for sex and time to admission, as well as datasets of patients transferred between hospitals in the acute phase, were excluded. Main outcome measures were the probability of being admitted within the first 3 hours of stroke onset and being treated with thrombolytic agents for both women and men, after adjustment for age, prestroke disability, severity of clinical symptoms, vascular risk factors, and final diagnosis.

Results—Fifty-three thousand four hundred fourteen patients were included (49.3% female; mean±SD age, 72.1±12.5 years). Women had a 10% lower chance of being admitted within the first 3 hours than men (odds ratio=0.902, 95% CI=0.860 to 0.945, \(P<0.001\)). This chance further decreased in elderly women. Similarly, the chance of a female stroke patient being treated with thrombolysis was 13% lower than that of a male patient (odds ratio=0.867, 95% CI=0.782 to 0.960, \(P=0.006\)). For patients admitted within the 3-hour time window, the chance of being treated with thrombolysis was similar for women and men (odds ratio=0.915, 95% CI=0.809 to 1.035, \(P=0.156\)).

Conclusions—We identified sex disparities in acute stroke management in terms of early hospital admission and thrombolytic treatment. This is best explained by the sociodemographic fact that “surviving spouses” are more likely to be women than men. Attempts to overcome disadvantages in their access to acute stroke care should focus on increased social support. (Stroke. 2007;38:2123-2126.)

Key Words: cerebral infarct ■ intracerebral hemorrhage ■ acute management ■ women

Despite the goal that women and men should have equal access to rapid emergency care,1 sex disparities are well documented in the management of myocardial ischemia, with women being diagnosed later and undergoing fewer coronary angiography and revascularization procedures than men.2-4 It is largely unknown whether similar differences exist in the management of acute stroke. Two publications reported that female stroke patients were less likely to undergo standard diagnostic tests than male patients.5,6 Likewise, women underwent carotid surgery and received antithrombotic medication less frequently than did men.6,7 A disproportionate sex ratio was also observed in the large, randomized recombinant tissue-type plasminogen activator stroke trials, in which only 40% to 42% of all patients were women.8-10 Similar findings were reported in several case series of acute stroke patients treated with thrombolysis.11-14 These findings deserve notice because despite a higher annual age-adjusted stroke risk in men, the total number of strokes is higher in women owing to their longer life expectancy.15 However, sex differences in stroke etiology and severity also influence acute treatment. For instance, large-artery atherosclerosis is more frequent in men, whereas cardioembolism is more common in women.15 This may explain why female stroke patients were, on average, more severely affected at the time of hospital admission than male patients.5,16 In addition, uncommon stroke symptoms were more frequently reported in women.17 Taking into account these potential biasing factors, this study attempted to identify and further analyze possible sex differences in acute stroke care, with respect to early hospital admission and thrombolytic therapy, in a prospective, countywide registry that included almost all consecutive stroke patients in the region.

Patients and Methods

Our analysis was based on a large, countywide stroke registry in Germany that was provided by the Arbeitsgruppe Schlaganfall Hessen...
Hessen (for details, see www.gqhnet.de). At present, >100 hospitals participate in enrolling patients with a final diagnosis of transient ischemic attack, cerebral infarction, or intracerebral hemorrhage into this standardized and computerized registry. All consecutive patients have to be registered, resulting in a proven >90% inclusion rate.

All parameters relevant to this analysis were documented prospectively. The severity of clinical symptoms at the time of hospital admission was assessed by the modified Rankin Scale (mRS). The level of consciousness (alert, somnolent, soporific, or coma), as well as deficits in motor function (no dysfunction; mono-, hemi-, or tetraparesis) and presence or absence of speech disturbances, was also recorded. Vascular risk factors included arterial hypertension and diabetes mellitus. Patients’ prestroke disabilities were determined at the time of hospital admission on the basis of all available information provided by the patient, relatives, or caregivers and were classified according to the mRS. The time from symptom onset to hospital admission was categorized as follows: 0 to 3 hours, 3 to 6 hours, 6 to 24 hours, >24 hours, or unknown. According to the application form, thrombolytic therapy was documented as either intravenous or intra-arterial.

For this analysis, we selected all cases in the entire database with hospital admission dates between January 1, 1999 and December 31, 2005 (n=91 656). Datasets with missing values for sex (n=61) and time to admission (n=3286), as well as datasets of patients transferred between hospitals in the acute phase of stroke (n=13 153), were excluded. Finally, we restricted our analysis to patients with a final diagnosis of cerebral infarction (ICD-10 I63, n=47 841) or intracerebral hemorrhage (ICD-10 I61, n=5573), omitting all remaining datasets (mainly patients with transient ischemic attack).

For the statistical analysis, we used a multivariate logistic-regression model to determine the influence of sex on early hospital admission and thrombolytic therapy. Adjustment was performed for the following variables: age (included continuously), prestroke disability (mRS 0, 1 versus >1), mRS at hospital admission (0 to 3 versus 4, 5), level of consciousness (alert versus somnolent, soporific, or coma), presence of speech disturbances, motor function (no deficit versus mono-, hemi-, or tetraparesis), type of stroke (ischemic versus hemorrhagic), arterial hypertension, or diabetes mellitus. As is to be expected in a prospective database, there were some values missing for each variable (see the Table).

The registry is a countywide, quality-assurance measure based on state law, for which all inpatients must be documented anonymously. Informed consent was not required before enrollment in the registry. The ethics review committee of the medical faculty of our university reviewed and approved the present analysis.

### Results

Of the 53 414 patients included in the final analysis, 26 319 patients were female (49.3%). The mean±SD age was 72.1±12.5 years. The baseline variables of the study population by sex are given in the Table. After multivariate adjustment, women were found to have a 10% smaller chance of being admitted within the first 3 hours of symptom onset than men (odds ratio [OR]=0.902, 95% CI=0.860 to 0.945, P<0.001). Compared with men, the probability of women being admitted to hospital within 3 hours of stroke onset decreased further with advancing age (see the Figure).

Within the dataset, 2021 ischemic stroke patients were documented as having been treated with thrombolytic agents, and 876 (43.5%) of these were female. One thousand six hundred fifteen patients received intravenous thrombolysis, and 406 received intra-arterial thrombolysis. After adjustment in the multivariate model, the chance of a female stroke patient being treated with either intravenous or intra-arterial thrombolysis was 13% lower than that of a male patient (OR=0.867, 95% CI=0.782 to 0.960, P=0.006). Whereas the sex ratio was balanced for younger stroke patients (in the first and second quartiles of age; OR=1.035, 95% CI=0.911 to 1.175, P=0.600), elderly female patients (in the third and fourth age quartiles) had a 25% smaller chance of receiving thrombolytic treatment (OR=0.753, 95% CI=0.634 to 0.895, P=0.001; see the Figure). For only those patients with ischemic stroke who reached the hospital within the 3-hour time window and who met the approval criteria for recombinant tissue-type plasminogen activator (ie, age between 18 and 80 years, moderate to severe neurological deficit [mRS 3 to 5], and not comatose; n=5088), the multivariate analysis showed that the chance of being treated with intravenous thrombolysis was not significantly different between women and men (OR=1.032, 95% CI=0.887 to 1.201, P=0.681). However, within the same model, a very strong sex disparity to the disadvantage of females was apparent.

## Table

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women (n=26 319)</th>
<th>Men (n=27 095)</th>
<th>Missing Values (Absolute Figures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean±SD, y</td>
<td>75.3±12.3</td>
<td>69.1±11.9</td>
<td>44</td>
</tr>
<tr>
<td>Prestroke mRS ≥2, %</td>
<td>27.5</td>
<td>18.9</td>
<td>7854</td>
</tr>
<tr>
<td>mRS at admission ≥4, %</td>
<td>51.9</td>
<td>39.4</td>
<td>681</td>
</tr>
<tr>
<td>Reduced consciousness, %</td>
<td>24.6</td>
<td>15.6</td>
<td>1063</td>
</tr>
<tr>
<td>Speech disturbance, %</td>
<td>31.8</td>
<td>28.0</td>
<td>569</td>
</tr>
<tr>
<td>Any paresis, %</td>
<td>74.7</td>
<td>72.8</td>
<td>3418</td>
</tr>
<tr>
<td>Arterial hypertension, %</td>
<td>77.3</td>
<td>76.1</td>
<td>168</td>
</tr>
<tr>
<td>Diabetes mellitus, %</td>
<td>29.9</td>
<td>29.4</td>
<td>538</td>
</tr>
<tr>
<td>Diagnosis (ICD-10 I61), %</td>
<td>10.2</td>
<td>10.6</td>
<td>0*</td>
</tr>
<tr>
<td>Admission &lt;3 hours, %</td>
<td>25.0</td>
<td>25.9</td>
<td>0*</td>
</tr>
<tr>
<td>Thrombolytic treatment, %</td>
<td>3.8</td>
<td>4.8</td>
<td>718</td>
</tr>
</tbody>
</table>

For each variable, the No. of missing values is given. *Variable was inclusion criteria (see Patients and Methods in text). †Numbers refer to ischemic stroke patients only.
women received this treatment in our sample. In this context, it is important to note that the attributable effect of thrombolytic treatment was shown to be entirely confined to women, which accentuates the need to aggressively and appropriately treat women for acute stroke.\textsuperscript{20} It is likely that the delayed admission of female stroke patients constitutes the main cause of the sex disparities in patients treated with thrombolysis. Thus, restricting our analysis to patients admitted within 3 hours after symptom onset revealed no significant sex difference regarding intravenous application. In other words, if stroke patients reach the hospital within the critical time window, emergency physicians do not appear to be biased toward a preferential treatment of one sex. However, we found that more aggressive forms of thrombolysis (ie, intra-arterial application) showed a particularly high sex disparity to the disadvantage of women, even within the 3-hour time window. This finding is apparently similar to studies in the cardiology field that have reported fewer coronary angiographies and interventional procedures in women.

Despite the substantial magnitude of the present study, our analysis is potentially hampered by some limitations: We have no comprehensive information on the comorbidity of the stroke population, which may influence admission latencies and decision making toward thrombolysis in the emergency situation. Furthermore, the proportion of missing values varies between items (see the Table), which may influence multivariate analyses.

In summary, all sex disparities observed in this study are best explained by the sociodemographic fact that “surviving spouses” are more likely to be women than men. Attempts to overcome disadvantages in their access to acute stroke care would have to focus on increased social support.

**Disclosures**

None.

**References**

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