Incidence of Stroke Among Inpatients in a Large Italian Hospital

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Background and Purpose

The incidence of stroke among inpatients is not known. The aim of our study was to investigate the incidence of stroke not preceded by evident iatrogenic factors such as surgical or medical procedures in a cohort of inpatients in a large Italian general hospital.

Methods

From January 1, 1992, to December 31, 1992, we evaluated patients referred to our neurology department with a suspected diagnosis of stroke that occurred during hospitalization. Patients presenting with stroke as a complication of iatrogenic causes were excluded. We calculated the incidence rate of first-ever stroke in our cohort (crude and among patients aged older than 50 years), thereafter adjusting these rates for age to the general population of the city district of Bologna (Italy).

Our neurology department performs more than 4200 clinical examinations requested every year by 67 medical and surgical wards in the S. Orsola-Malpighi general hospital. In our practice the occurrence of stroke in inpatients is not uncommon. To our knowledge no data have been published on stroke incidence in an unselected population of inpatients. In previous studies a percentage of strokes ranging from 5.4% to 8.7% occurred while the patients were already hospitalized for other causes. Stroke occurring in a hospitalized patient may be iatrogenic. In some patients, however, the occurrence of stroke is not clearly subsequent to particular medical or surgical procedures. To determine if the hospital is a high-risk environment for stroke we calculated the crude and age-adjusted incidence rates of first-ever stroke in our cohort and compared them to those of Italian community-based studies.

Subjects and Methods

S. Orsola-Malpighi is one of the two major general hospitals in the city of Bologna, Italy, which has a population of approximately 500,000. It provides 2543 beds distributed in 67 wards, including not only general and specialized medical and surgical care but also highly specialized departments (such as cardiology and cardiosurgery intensive care, organ transplantation surgical wards, and respiratory physiopathology).

From January 1, 1992, to December 31, 1992, we evaluated all patients with a diagnosis of stroke that occurred during hospitalization. The diagnosis of stroke, based on the criteria proposed by the World Health Organization, was made by a neurologist, called in by a ward physician, as routinely happens in our hospital when an inpatient presents neurological symptoms. All wards in the hospital had previously been alerted to the study. Risk factors for cerebrovascular disease (including hypertension, diabetes, atrial fibrillation, and coronary artery disease) were recorded, as well as previous transient ischemic attacks or strokes. We also recorded diagnostic and therapeutic procedures, laboratory tests, drug treatments before stroke, and computed tomographic scans when performed.

Because we wanted to compare the stroke frequency rates of our cohort with the stroke incidence rates of the general population, we adopted the following formula:

\[
\text{No. of Inpatients} \times \text{Mean Hospitalization of Inpatients (Days)} \times \frac{365}{1000} = \text{Stroke Incidence Rate}
\]

We calculated the incidence rates (crude and among patients aged older than 50 years) of first-ever stroke in our population, and we adjusted them for age to the population of the city district of Bologna (estimated on December 31, 1987). A two-tailed Fisher's exact test was used to compare prevalence of risk factors for stroke in our series and in the Valle d'Aosta community-based study and between inpatients who died and those who survived at 30 days in our series of first-ever strokes.

Results

In 1992, 22 inpatients had a first-ever stroke with no evidence of iatrogenic factors. The crude stroke incidence rate was 11.08/1000 per year (95% confidence interval, 6.95 to 16.73). The age-adjusted rate was 5.46 (95% confidence interval, 3.42 to 8.24).

Conclusions

The incidence rate of first-ever stroke among hospitalized patients is higher than those reported in community-based studies. Higher frequency of coronary artery disease among our patients could explain our findings. Further studies are needed to identify possible predisposing factors (individual or environmental) for stroke among inpatients.

Key Words • cerebrovascular disorders • epidemiology • incidence

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In 26 cases there was no clear correlation between stroke and any medical or surgical procedure. Stroke occurred after surgery in 8 patients with a mean interval of 12.8 days (median, 10 days; range, 3 to 36 days). In the remaining 18 there was a mean interval of 5.8 days (median, 4 days; range, 1 to 16 days) between hospital admission and occurrence of stroke. Twenty-two of these patients had a first-ever stroke. Ten were men, with a mean age of 74 years (range, 26 to 88 years); 10 patients (45%) died within 30 days from onset. Seventeen had a computed tomographic scan, which disclosed hemorrhagic stroke in 2. Twenty (91%) had one or more risk factors for cardiovascular disease. Considering 12 patients who survived and 10 who died within 30 days after a first-ever stroke, we did not find any clinical or statistical difference concerning age (range, 60 to 88 years; mean, 76 years; median, 76 years versus range, 26 to 88 years; mean, 71 years; median, 78 years, respectively), type of underlying disease leading to hospitalization, or distribution of risk factors for cerebrovascular disease such as hypertension (n=9 versus n=6, respectively), diabetes (n=2 versus n=2), arrhythmia (n=4 versus n=2, respectively), coronary artery disease (n=4 versus n=2, respectively), and previous transient ischemic attacks (n=3 versus n=1, respectively). Diagnoses on admission and intervals between hospitalization or surgery and stroke are shown in Table 1.

Considering 22 patients with first-ever stroke and no clear iatrogenic factors, the crude stroke incidence rate was 11.08/1000 per year (95% confidence interval [CI], 6.95 to 16.73). The age-adjusted stroke incidence rate was 5.46 (95% CI, 3.42 to 8.24). The first-ever stroke incidence rate among patients aged older than 50 years was 15.36 (95% CI, 9.51 to 23.50). The age-adjusted rate among patients aged older than 50 years was 11.16 (95% CI, 6.91 to 17.07). We also calculated these incidence rates for men and women (Table 2). Considering separately all medical and all surgical admissions, the crude stroke incidence rates for these two subgroups in our cohort of inpatients were 11.99 (95% CI, 6.71 to 19.78) and 9.97 (95% CI, 3.99 to 20.54), respectively.

**Discussion**

In our experience acute cerebrovascular events are not uncommon among inpatients admitted for noncerebrovascular diseases. To our knowledge no previous studies have provided data on incidence of stroke in an unselected cohort of hospitalized patients.

We observed 42 patients presenting with stroke during hospitalization. In our study detection of strokes among inpatients depended on referral by the physician of each ward. We may have underestimated the real number of strokes, since we cannot assume that all physicians requested neurological examination, particularly for patients with mild neurological symptoms, even though all wards had been informed of the study.

Stroke complicated various diagnostic and therapeutic procedures in 16 patients. These patients, however, were excluded from further analysis because the frequency of iatrogenic stroke depends on hospital-related variables (such as type and frequency of procedures and morbidity of surgical teams). Therefore, the incidence of iatrogenic stroke may vary among hospitals.

Twenty-six patients had a stroke during hospitalization with no evidence of triggering factors. Twenty-two were first-ever strokes; of these, 15 had been admitted for medical emergencies, while in 7 patients stroke was preceded by surgical procedures (Table 1). Considering that the mean interval between surgery and stroke was quite long, that stroke as a complication of general surgical procedures is less than 1%,9 and that none of these patients had surgery or postoperative treatments that could predispose them to cerebrovascular events, we decided to include these patients in the group of stroke without iatrogenic factors.

In 22 inpatients with first-ever stroke and no iatrogenic factors, the age-adjusted stroke rate was 5.46 (95% CI, 3.42 to 8.24), higher than that reported in the SEPIVAC and Valle d’Aosta community-based studies. The stroke rates in these studies were 2.2/1000 (95% CI, 1.81 to 2.66) and 2.23/1000 (95% CI, 1.96 to 2.50), respectively. The difference between our results and theirs was statistically significant. Although in the male subgroup of our series the incidence rate was higher than those reported in the community-based studies mentioned above, the difference was not statistically significant, probably because of the small numbers in our study.

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**Table 1. Diagnosis on Admission and Delay Between Hospitalization or Surgery and Stroke in 22 Inpatients With First-Ever Stroke and No Evidence of Iatrogenic Factors**

<table>
<thead>
<tr>
<th>Pt No.</th>
<th>Cause of Hospitalization</th>
<th>Time From Hospitalization, d</th>
<th>Time From Surgery, d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acute myocardial infarction</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Acute myocardial infarction*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Acute myocardial infarction*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cardiac failure</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cardiac failure</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Chest pain*</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Renal failure*</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Renal failure</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Dizziness*</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hyperpyrexia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pemphigoid*</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Jaundice*</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Chest trauma</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Acute pancreatitis*</td>
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<td></td>
</tr>
<tr>
<td>15</td>
<td>Partial bowel obstruction</td>
<td>15</td>
<td></td>
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<tr>
<td>16</td>
<td>Right leg amputation*</td>
<td>69</td>
<td>17</td>
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<tr>
<td>17</td>
<td>Zenker diverticulum</td>
<td>10</td>
<td>8</td>
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<tr>
<td>18</td>
<td>Esophageal cancer</td>
<td>13</td>
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<tr>
<td>19</td>
<td>Colon carcinoma</td>
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<td>8</td>
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<tr>
<td>21</td>
<td>Colon carcinoma</td>
<td>39</td>
<td>36</td>
</tr>
<tr>
<td>22</td>
<td>Gastric carcinoma*</td>
<td>17</td>
<td>8</td>
</tr>
</tbody>
</table>

*Patient died within 30 days from onset of stroke.
TABLE 3. Prevalence of Risk Factors for Stroke In Coronary artery disease was lower (61.8 versus 69 years). Furthermore, because ischemic attack (Valle d'Aosta Community-Based Study)

Previous transient ischemic attack (Valle d'Aosta Community-Based Study)

Diabetes

Hypertension

Arrhythmia

Coronary artery disease

Previous transient ischemic attack

To calculate our rates, we could not consider a 365-day period because our population was continuously changing. Therefore, we adopted a formula in which “time” was represented by the number of periods of exposure to risk factors of our cohort of inpatients. This was obtained by substituting, in the usual incidence rate formula, the value representing time (365 days) with the relation between 365 days and the mean number of hospitalization days of all inpatients.

Distribution of risk factors for cerebrovascular disease in our first-ever stroke group showed a similar morbidity when compared with the prevalence of the same risk factors in outpatients with first stroke. Inpatients also showed a higher prevalence of coronary artery disease, reaching a probability value close to statistical significance (Table 3).

Overall mortality at 30 days was 38% (n=16), considerably higher than in a series of 21 inpatients by Kelley and Kovacs (19%). However, these authors only considered ischemic strokes, and mean age in their group was lower (61.8 versus 69 years). Furthermore, because of our recruitment method, we may have underestimated the number of mild strokes, thereby obtaining a lower mortality.

In our series, 61% of inhospital strokes were not preceded by high-risk medical or surgical procedures. Therefore, such an event, although not very common, must also be considered in patients admitted for noncerebrovascular diseases. Inhospital strokes can be diagnosed and treated very soon after onset, since delays in transportation are obviously eliminated, and many studies have emphasized the need for a rapid initiation of therapy in acute stroke, especially in regard to promising treatments such as thrombolysis. According to a recent report by Alberts et al11 more than 50% of inhospital strokes might be eligible for a clinical trial within a 6-hour enrollment window.

Our data suggest that hospitalized patients are at high risk for stroke even in the absence of iatrogenic procedures. This is probably due to individual predisposing factors of inpatients (eg, higher prevalence of coronary artery disease) and to environmental factors related to hospitalization (eg, changes in drug therapy, surgery, and prolonged bed rest).

Further studies are needed to investigate risk factors for stroke among inpatients. In-hospital strokes should be followed by rapid diagnosis and early initiation of standard therapy. Some of these patients could also be considered for clinical trials of new treatments with very narrow enrollment windows.

Acknowledgments

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References

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