Intracerebral hemorrhage more than twice as common as subarachnoid hemorrhage

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The authors report a study of all instances of spontaneous intracerebral hemorrhage (ICH) (188 cases) and subarachnoid hemorrhage (SAH) (80 cases) that occurred in the Greater Cincinnati area during 1988. Adjusted for age, sex, and race, the annual incidence of ICH was 15 per 100,000 population (95% confidence interval 13 to 17) versus six per 100,000 for SAH (95% confidence interval 5 to 8). The incidence of ICH was at least double that of SAH for women, men, and whites and approximately 1½ times that for blacks. The 30-day mortality rate of 44% for ICH was not significantly different from the 46% mortality rate for SAH. Despite the evidence that ICH is more than twice as common and the disorder just as deadly as SAH, clinical and laboratory research continues to focus primarily on SAH.

KEY WORDS: intracerebral hemorrhage, subarachnoid hemorrhage, epidemiology, mortality

In several community and cohort studies during the period from 1950 to 1980, subarachnoid hemorrhage (SAH) was reported to be at least as common and substantially less likely to be fatal than intracerebral hemorrhage (ICH). In the Framingham Study, SAH was reported to occur almost three times as commonly as ICH among persons aged 30 to 88 years. The 30-day mortality rate from SAH in Rochester, Minnesota, between 1945 and 1974 ranged from 44% to 67% compared to 86% to 91% for ICH. Case definitions for these epidemiological studies relied upon the neurological history and examination, cerebrospinal fluid analysis, and autopsy findings, but included few computerized tomography (CT) studies.

One of the goals of the present study was to compare the relative occurrence and mortality rate of ICH and SAH during the era of CT in the large metropolitan population of Greater Cincinnati, a five-county region in southeastern Ohio and northern Kentucky. Its nearly 1.3 million population during 1980 had a similar proportion of blacks (14%) as the United States population (12%) as well as an almost identical median age (29 vs. 30 years). Computerized tomography is available at all hospitals in the study region as well as at outpatient facilities, and is part of the standard evaluation of stroke within the community.

Clinical Material and Methods

The medical records of all patients who had a possible ICH or SAH within the Greater Cincinnati metropolitan area during 1988 were reviewed. This review included the record systems of all 20 acute-care hospitals and coroners' offices within the five-county region. The catchment area for these hospitals exceeds the geographic region of the five counties, assuring complete case ascertainment of hospitalized strokes. Persons with an ICH or SAH who may have escaped identification include those who suffered a stroke in a nursing home or at home but who were not admitted to the hospital prior to death and did not undergo autopsy. The International Classification of Disease (ninth revision) ICD-9-CM codes that were used for retrieval of medical records included those for ICH (431 and 432.9), SAH (430), cerebral aneurysm (747.81), arteriovenous malformation (437.3 and 442.81), and cerebrovascular accident (436). Both primary and secondary discharge diagnoses were included in the screening. Since cases were often coded by the discharge date, all potential cases between January 1, 1988, and March 1, 1989, were screened, but only cases with onset of hemorrhage between January 1 and December 31, 1988, were included. All medical records were reviewed by a trained nurse abstractor under close supervision of a neurologist (J.P.B.). The abstracted clinical data as well as all available CT scans and magnetic resonance (MR) films for each case were evaluated by a neurologist. Films were unavailable for 25 of 255 hospitalized cases, and for these the CT report in the medical record was utilized. Except for cases identified by autopsy records alone, all patients had at least one CT scan obtained at the time of stroke evaluation. A neuroradiologist re-

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![Graph showing incidence rates for ICH and SAH](image)

**FIG. 1.** Age-adjusted incidence rates of intracerebral hemorrhage and subarachnoid hemorrhage by gender and race. Vertical lines on top of bars represent an upper confidence limit, with \( \alpha = 0.025 \). Two cases of intracerebral hemorrhage, a Hispanic woman and a woman native to India, are not included in the incidence rates for whites and blacks.

Confidence intervals for the incidence were calculated using a Poisson distribution.16 The 30-day survival rate after ICH and SAH for blacks and whites was calculated by Kaplan-Meier life-table analysis.14 Years of potential life lost,7 a measure of premature mortality, were calculated for both ICH and SAH.

**Results**

From examination of 3233 medical records, 188 cases of ICH and 80 cases of SAH were found to have occurred during 1988. There were an additional 11 cases of recurrent hemorrhage (eight with ICH and three with SAH). Of the 268 cases of intracranial hemorrhage, two cases of ICH and 11 cases of SAH were identified by autopsy reports alone. Of the remaining cases, all but two patients with SAH, who had bloody cerebrospinal fluid and an appropriate clinical history, had the hemorrhage documented by CT scan.

Adjusted for age, sex, and race, the incidence of ICH was 15 per 100,000 population (95% confidence interval 13 to 17) versus six per 100,000 for SAH (95% confidence interval 5 to 8). The incidence of ICH was at least double that of SAH for women, men, and whites and approximately 1.5 times that of SAH for blacks (Fig. 1). The incidence of ICH increased exponentially with advancing age, whereas the rate of SAH increased slightly after 35 years of age (Fig. 2). The 30-day mortality rate of 44% for ICH was not significantly different from the 46% mortality rate for SAH. The annual rate of years of potential life lost due to ICH was 0.3 per 1000 persons under 65 years of age as compared to 0.4 per 1000 persons under 65 years of age for SAH.

Among the 188 cases of ICH, 10 were due to a ruptured arteriovenous malformation and three to hemorrhage into a tumor. Other associated conditions included administration of anticoagulant drugs in nine, thrombolytic therapy for a pulmonary embolism in one and for a myocardial infarction in one, and acute co-

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caine ingestion in one. Of the 188 patients, 128 (68%) had a prior history of hypertension.

In the 80 SAH cases, two causes were verifiable. An intracranial aneurysm was identified in 43 cases, documented by angiography in 31 cases, at autopsy in nine, and during operative removal of an associated parenchymal hemorrhage in three. There were two cases of arteriovenous malformation, both documented at autopsy. Of the remaining 35 hospitalized patients with SAH, 11 had normal angiograms; poor clinical condition precluded cerebral angiography in the rest. No aneurysm was seen in 11 of the 42 patients who underwent angiography.

Discussion

Intracerebral hemorrhage occurred at least twice as often as SAH during 1988 in a five-county population of nearly 1.3 million. This observation was true for men, women, and whites. The difference in incidence rates between ICH and SAH in blacks was somewhat less. As the Greater Cincinnati area is comparable to the United States population with respect to age, education, and percentage of blacks, our findings suggest that ICH occurs annually in approximately 37,000 United States residents as compared to 15,000 with SAH. With 2850 board-certified neurosurgeons practicing in the United States as of November, 1991 (personal communication, American Board of Neurological Surgery), this incidence would correspond to an average of 13 ICH's and five SAH's per neurosurgeon each year. These figures are likely overestimates since more than 10% of patients with SAH die before reaching the hospital, and neurologists or internists provide primary care for many patients with ICH or SAH.

The substantially greater occurrence of ICH as compared to SAH contrasts with several earlier community studies, but is quite consistent with community studies in the CT era (Table 1). The marked discrepancies between earlier and more recent studies reflect the revolutionary impact of CT on the accurate diagnosis of ICH. Many smaller ICH's which in the pre-CT era were diagnosed clinically as cerebral infarcts are now easily identified by CT. Conversely, some large cerebral infarcts that produced early changes in a patient's level of consciousness were misclassified as being ICH. Less commonly appreciated is the misclassification of an ICH that ruptures into the subarachnoid space or ventricular system and, like SAH, may present with coma, stiffness of the neck, and bloody cerebrospinal fluid. Focal neurological findings typically ascribed to ICH may be obscured by the bilateral severity of the brain insult. In our study, ICH and SAH occurred together in 20 of the 268 patients. Intracerebral hemorrhage with intraventricular extension occurred in 88 (52%) of 168 patients for whom CT films were available. Five patients had only intraventricular hemorrhage. In these clinical settings, in addition to angiography or autopsy, CT is essential to determine the origin of the bleeding.

The impact of ICH and SAH upon young and middle-aged Americans is similar, despite earlier reports that emphasize the pre-eminence of SAH in this age group. In the present study, 60 patients with ICH were under the age of 65 years as compared to 59 cases of SAH. The years of potential life lost before the age of 65 years, a measure of premature mortality, were similar for ICH and SAH.

Our results suggest that ICH is substantially more common than SAH nationally and just as deadly. Nonetheless, clinical and laboratory research have focused primarily on SAH. Probably the most important reason for the emphasis upon SAH is the perception that it is a treatable disease while ICH is not. Clipping of ruptured aneurysms reduces the risk of rebleeding, while volume expansion and calcium channel blockers appear to reduce the morbidity associated with arterial vasospasm. In contrast, the three randomized trials of surgery and a randomized trial of dexamethasone have not demonstrated benefit for patients with ICH.

Therapeutic achievements in cases of SAH have followed the technological developments in the aneurysm

<table>
<thead>
<tr>
<th>Location, Study Period, &amp; Reference No.</th>
<th>Rate/100,000 (nos.)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Rochester, Minnesota, 1975-79⁸</td>
<td>13 (38) 12 (32)</td>
<td>CT in 51% of cases</td>
</tr>
<tr>
<td>Shibata, Japan, 1976-78⁹</td>
<td>39 (97) 12 (31)</td>
<td>CT in minority of cases</td>
</tr>
<tr>
<td>Tilburg, The Netherlands, 1978-80¹</td>
<td>17 (54) 8 (24)</td>
<td>CT or brain scan in 56% of stroke patients</td>
</tr>
<tr>
<td>Kuopio, Finland, 1978-80²</td>
<td>23 (29) 18 (24)</td>
<td>CT in 8% of stroke patients</td>
</tr>
<tr>
<td>South Alabama, 1980³</td>
<td>23 (13) 16 (9)</td>
<td>Crude rates for population aged ≥ 20 yrs; CT in all patients with ICH or SAH</td>
</tr>
<tr>
<td>Rochester, Minnesota, 1980-84⁴</td>
<td>15 (42) 8 (24)</td>
<td>CT in 84% of stroke patients</td>
</tr>
<tr>
<td>Benghazi, Libya, 1983-84⁵</td>
<td>9 (48) 3 (15)</td>
<td>CT in 80% of all stroke cases</td>
</tr>
<tr>
<td>Oxfordshire, England, 1981-86⁶</td>
<td>14 (66) 7 (33)</td>
<td>CT in 80% of stroke patients</td>
</tr>
<tr>
<td>Soderhamn, Sweden, 1983-86⁷</td>
<td>22 (35) 8 (10)</td>
<td>CT in 37% of stroke patients</td>
</tr>
<tr>
<td>Dijon, France, 1983-89⁸</td>
<td>12 (87) 4 (15)</td>
<td>Only ICH ratio is age-adjusted; SAH is crude overall rate; CT in 90% of stroke patients</td>
</tr>
<tr>
<td>Greater Cincinnati, Ohio, 1988</td>
<td>15 (188) 6 (80)</td>
<td>CT or autopsy corroboration in all but two cases</td>
</tr>
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</table>

* ICH = intracerebral hemorrhage; SAH = subarachnoid hemorrhage; CT = computerized tomography. The incidence rates are age-adjusted to 1970 United States population except as noted. The Rochester figures are age- and sex-adjusted, and both 1975-1979 and 1980-1984 rates were obtained from J Broderick and JP Whisnant (unpublished data).
† Data include recurrent as well as first-ever brain hemorrhages.
‡ Actual number of cases not reported, number of cases estimated from reported incidence rates and population figures assumes no cases in 0-25-year-old age group.

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clip and operating microscope as well as advances resulting from better understanding of the early natural history and pathophysiology. Further research into the natural history, pathophysiology, and treatment of ICH is needed. Hopefully, innovative surgical and medical therapies will follow.

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References


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