Primary Subarachnoid Hemorrhage in Iceland

BY GUNNAR GUDMUNDSSON, M.D.

Abstract:
This study was undertaken to estimate the incidence of primary subarachnoid hemorrhage among the population of Iceland during the 11-year period from 1958 through 1968. The incidence for the whole country was 8.0/100,000—males 9.1 and females 6.9. The incidence was significantly higher in Reykjavik (the capital) (10.5/100,000) than the area outside Reykjavik (rural and villages) (5.9/100,000).

In the rural area the incidence was significantly higher for males (7.47/100,000) than for females (4.32/100,000). This difference was not found in the city.

The incidence for Reykjavik is similar to the one found in comparable studies.

Additional Key Words: incidence, population study, Reykjavik

Introduction
The purpose of the present study was to estimate the incidence of primary subarachnoid hemorrhage (SAH) in Iceland. The criteria used in this study are similar to those of Pakarinen1 in his study in Helsinki: (1) sudden onset of headache, signs of meningeal irritation and sometimes evidence of cerebral irritation and deficit; (2) SAH is diagnosed by the detection of blood in the cerebrospinal fluid by lumbar puncture or autopsy. (3) The following points were observed in differentiating primary SAH from secondary SAH due to primary intracerebral hemorrhage. The following patients were excluded: those over the age of 50 who were either (a) dying from the initial hemorrhage or surviving with a severe neurological deficit or (b) were hypertensive and surviving after a prolonged initial coma (more than 24 hours); and those under the age of 50 who either had (a) preceding hypertension, or were dying from the initial hemorrhage or surviving with a severe neurological deficit, or (b) were normotensive with a severe neurological deficit and dying from the initial hemorrhage.

It is obvious that it often can be difficult to decide whether one is referring to a primary or a secondary SAH, and this will perhaps be one of the causes leading to discrepancies between recorded incidence in various epidemiological studies published.

This study includes the whole population of Iceland, which is particularly favorable for epidemiological investigations. The author is not aware of any survey of SAH extending to a whole nation.

Methods
It is necessary to give a brief account of the country and its people if one is to demonstrate the advantages of undertaking epidemiological research in Iceland.

Iceland is a large island in the North Atlantic which touches the Arctic Circle and is about 850 kilometers northwest of Scotland and about 1,050 kilometers west of Norway. Its area is 103,000 square kilometers. Only one-fifth of the land is habitable, with the remainder consisting of highlands, mountains, and glaciers. Fishing and fish-processing industries are the principle occupational resources of the inhabitants. The major changes in occupation during the last two decades in Iceland have been an increase in manufacturing and services and a decrease in agriculture.

The inhabitants are descendants of Norwegian Vikings who settled in Iceland in the years 874 AD to 930 AD with a considerable admixture from the British Isles. According to the census of 1703, which must have been one of the earliest carried out in Europe, the Icelanders numbered a little over 50,000. Since the beginning of the present century there has been a steady and substantial increase of the population, bringing it to a total of 203,695 in 1968.2 Although the nation today can be divided according to a wide variety of occupations among its citizens, they all have one thing in common; namely, they are virtually all the children and/or grandchildren of farmers, fishermen or laborers.

Iceland is divided into 55 medical districts, each having a district physician. A national health service has been in operation since 1936 and provides almost free medical service. Old age and disability insurance have been carried out in the country since that time.

The total number of beds in 42 hospitals is 2,153, of which there are 1,258 beds in 29 general hospitals.3 In Reykjavik there are three general hospitals. The first and only department of neurology was opened in 1967, but until that time all patients with neurological disorders and in need of hospitalization were admitted to the medical departments. Until 1969, there were only two neurologists in Iceland.
The overall autopsy rate in Iceland in the age group 33 to 70 was 54.2% for the year 1967. The autopsy rate is higher in the Reykjavik area, or 66.9%, compared with 34.5% in the area outside Reykjavik. The autopsy rate in the Reykjavik area in the age group 33 to 60 is 71.9%.

Almost all cases suspected of suffering from SAH and living outside the Reykjavik area are referred to the hospitals in Reykjavik.

Cerebral angiography has been performed in Iceland since 1961. Formerly, a selected number of cases was referred to the department of neurosurgery at the State Hospital in Copenhagen, Denmark (Rigshospitalet). During the period of investigation, all neurosurgery on patients with aneurysm or AVM had been performed there.

Approximately 55% of the patients with primary SAH were investigated clinically and neuroradiologically in the acute phase.

The collection of data started in 1967. All patients admitted to the hospitals in Reykjavik since 1958 and having the diagnosis of (1) subarachnoid hemorrhage, (2) cerebral aneurysm, (3) cerebral angiomia, or (4) cerebral AVM were recorded.

At the same time the names of all patients aged 35 or younger with the diagnosis of cerebral hemorrhage, cerebral embolism or cerebral thrombosis also were recorded for scrutiny and separate study. The case records of all these patients were carefully studied.

Physicians of all hospitals outside the Reykjavik area were contacted concerning patients with the above-mentioned diagnoses. According to their information all patients with SAH were referred to Reykjavik with the exception of several patients who had died shortly after admission, and in such cases the diagnosis would be recorded on the death certificate.

The author made several visits to the local hospitals and medical districts during the years of investigation, collecting further data and following up the fate of patients, and re-examining most of those still alive.

All 5,604 autopsy reports, including 1,076 medicolegal autopsies performed in the department of pathology during the period from January 1, 1958, to December 31, 1968, were studied. By studying death certificates from 1958 through 1968 having the above-mentioned diagnoses, 77 patients were found to have died because of primary SAH, of which 27 had not been discovered by the other sources of information. Autopsy had been done on 14 of these 27 patients. After further inquiries eight were discarded as primary SAH.

It was thought possible that among those cases diagnosed as cerebral hemorrhage, cerebral embolism, cerebral thrombosis and hemiplegia there could be some suffering from primary SAH. A search to discover such cases was made by investigating a randomly selected group of 129 cases which had been admitted to the main hospitals with the diagnoses mentioned above. One patient, or less than 1%, thus was discovered, who probably was suffering from primary SAH.

Information was obtained on 248 patients; of these, 66 cases were discarded as they did not fulfill the criteria used, and in addition, 18 cases with hereditary cerebral hemorrhage (families in Iceland with primary amyloidosis of the cerebral arteries) were discarded.

Thus a total of 164 patients were included in the present study. Table 1 shows the sources of information obtained and place of residence.

### Results

As previously mentioned, the present series comprises all diagnosed cases of primary SAH among the population of Iceland during the 11-year period from January 1, 1958, through December 31, 1968. A total of 164 patients were included in this survey, 94 males and 70 females. The author had examined 89 of the patients in the acute phase of the disease (50 males and 39 females), or 54%.

Of all the material gathered, the author found 133 patients (81%) had been admitted to hospitals in Reykjavik.

### TABLE 2

**Age and Sex Distribution in the Population of Iceland (Average Figures for the Years 1958 through 1968)**

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>22,966</td>
<td>21,748</td>
<td>44,714</td>
</tr>
<tr>
<td>10 - 19</td>
<td>18,248</td>
<td>17,318</td>
<td>35,566</td>
</tr>
<tr>
<td>20 - 29</td>
<td>12,751</td>
<td>12,310</td>
<td>25,061</td>
</tr>
<tr>
<td>30 - 39</td>
<td>11,763</td>
<td>11,241</td>
<td>23,004</td>
</tr>
<tr>
<td>40 - 49</td>
<td>9,913</td>
<td>9,604</td>
<td>19,517</td>
</tr>
<tr>
<td>50 - 59</td>
<td>7,922</td>
<td>7,867</td>
<td>15,789</td>
</tr>
<tr>
<td>60 - 69</td>
<td>5,845</td>
<td>6,252</td>
<td>12,097</td>
</tr>
<tr>
<td>70 -</td>
<td>4,309</td>
<td>5,448</td>
<td>9,757</td>
</tr>
<tr>
<td>Total</td>
<td>93,717</td>
<td>91,788</td>
<td>185,505</td>
</tr>
</tbody>
</table>
The average population of Iceland (table 2) for the years 1958 to 1968 was 185,505 (males 93,717 and females 91,788). For the determination of incidence, only those patients whose first bleeding occurred from January 1, 1958, through December 31, 1968, were considered.

The incidence for the whole country is 8.0 per 100,000 population per year—males 9.1 and females 6.9.

The incidence of primary SAH in the age group 0 to 9 is 1.8/100,000, and in the age group 10 to 19 is 2.3/100,000 (table 3). In the age group 0 to 9 there were three children who died when just a few days old, but no explanation for the hemorrhage was found at postmortem. Table 4 shows the annual incidence rate per 100,000 population. The incidence for the Reykjavik area is 10.5/100,000, males 11.1 and females 9.8. Outside the Reykjavik area the incidence was 5.9/100,000, males 7.4 and females 4.3.

Further investigation into patients dying during the first to seventh day after primary SAH showed the death rate to be 29.5% for those residing in the Reykjavik area and 30.3% for those residing outside Reykjavik.

**Discussion**

Published series on primary SAH have shown that the incidence varies from 4 to 55 cases per 100,000 population annually. This large difference is presumably due to different diagnostic criteria and selection of the material.

The diagnostic criteria used in the present study are similar to those of Pakarinen. Other studies, which on the basis of diagnostic criteria can be considered comparable, are those of Broman and Norlén in Gothenburg, Whisnant et al. in Rochester, and probably also Brewis et al. in Carlisle.

The present study shows a significantly higher incidence of primary SAH in the Reykjavik area (10.5/100,000) than outside the Reykjavik area (5.9/100,000) annually.

The incidence for the Reykjavik area is similar to the one found in cities as shown in table 5, with the exception of Helsinki.

It was thought possible that the marked urban-rural difference found in the present study was due to loss of cases in rural areas because of death at home in the first days of the illness. However, when the death rate in the first week of illness was studied according to the residence of the patients, no difference was found (29.5% urban and 30.3% rural). The incidence in the age groups 0 to 9 and 10 to 19 in the present study is high compared with other studies (table 6). The annual incidence through the period of investigation does not show any trends, being on the average 8.0 for the period 1958 through 1968 (table 4). There was no significant difference in the annual incidence by sex for the whole country, females 6.9/100,000 and males 9.1/100,000, or for the Reykjavik area, females 9.9/100,000 and males 11.2/100,000. The annual incidence for the area

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**Table 3**

Age-Specific Average Annual Incidence Rate Per 100,000 Population (Iceland 1958 through 1968)

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Average population at risk</th>
<th>Number of cases</th>
<th>Average annual incid. rate/100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>44,714</td>
<td>9</td>
<td>1.8</td>
</tr>
<tr>
<td>10 - 19</td>
<td>35,566</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>20 - 29</td>
<td>25,061</td>
<td>14</td>
<td>5.0</td>
</tr>
<tr>
<td>30 - 39</td>
<td>23,004</td>
<td>23</td>
<td>9.0</td>
</tr>
<tr>
<td>40 - 49</td>
<td>19,517</td>
<td>35</td>
<td>16.3</td>
</tr>
<tr>
<td>50 - 59</td>
<td>15,789</td>
<td>40</td>
<td>23.0</td>
</tr>
<tr>
<td>60 - 69</td>
<td>12,097</td>
<td>21</td>
<td>15.7</td>
</tr>
<tr>
<td>70 -</td>
<td>9,757</td>
<td>13</td>
<td>12.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>185,505</strong></td>
<td><strong>164</strong></td>
<td><strong>8.0</strong></td>
</tr>
</tbody>
</table>

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**Table 4**

Annual Incidence Rate Per 100,000 Population (Iceland 1958 through 1968)

<table>
<thead>
<tr>
<th>Year of onset</th>
<th>Males</th>
<th>Females</th>
<th>M + F</th>
<th>Number of cases</th>
<th>Males</th>
<th>Females</th>
<th>M + F</th>
<th>Annual incidence rate/100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>86,076</td>
<td>84,488</td>
<td>170,564</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>87,979</td>
<td>86,276</td>
<td>174,255</td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>89,892</td>
<td>88,000</td>
<td>177,892</td>
<td>8</td>
<td>7</td>
<td>15</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>91,355</td>
<td>89,410</td>
<td>180,765</td>
<td>11</td>
<td>7</td>
<td>18</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>93,002</td>
<td>90,989</td>
<td>183,991</td>
<td>9</td>
<td>5</td>
<td>14</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>94,708</td>
<td>92,606</td>
<td>187,314</td>
<td>12</td>
<td>7</td>
<td>19</td>
<td>10.1</td>
<td></td>
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<tr>
<td>1964</td>
<td>96,230</td>
<td>94,332</td>
<td>190,562</td>
<td>14</td>
<td>4</td>
<td>18</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>98,013</td>
<td>95,906</td>
<td>193,919</td>
<td>10</td>
<td>7</td>
<td>17</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>99,696</td>
<td>97,525</td>
<td>197,221</td>
<td>5</td>
<td>16</td>
<td>21</td>
<td>10.3</td>
<td></td>
</tr>
</tbody>
</table>

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outside Reykjavik, on the other hand, was significantly higher (P<0.05) for males (7.5/100,000) than for females (4.3/100,000). It is possible that better diagnostic assessment in urban areas is responsible for this difference.

The results of this study, covering the total population of Iceland, indicate a higher incidence of primary SAH in the Reykjavik area (urban) than in mainly rural areas.

Acknowledgments

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