The Incidence of Cerebral Venous Thrombosis
A Cross-Sectional Study

Jonathan M. Coutinho, MD; Susanna M. Zuurbier, MD; Majid Aramideh, MD, PhD; Jan Stam, MD, PhD

Background and Purpose—The purpose of this study was to determine the incidence of adult cerebral venous thrombosis.

Methods—A retrospective cross-sectional study was conducted among all 19 hospitals located in 2 Dutch provinces serving 3.1 million people. Adult cerebral venous thrombosis cases diagnosed between January 1, 2008, and December 31, 2010, were identified using the Dutch financial coding system for hospital care and the International Classification of Diseases, 9th Revision. Medical records of potential patients were hand searched to identify cerebral venous thrombosis cases. The Dutch National Bureau for Statistics provided population figures of the 2 provinces during 2008 to 2010.

Results—Among 9270 potential cases, we identified 147 patients diagnosed with cerebral venous thrombosis. Of these, 53 patients did not meet the inclusion criteria; therefore, 94 patients were included in the analysis. The overall incidence was 1.32 per 100 000 person-years (95% CI, 1.06–1.61). Among women between the ages of 31 and 50 years, the incidence was 2.78 (95% CI, 1.98–3.82).

Conclusions—The incidence of cerebral venous thrombosis among adults is probably higher than previously believed. (Stroke. 2012;43:00-00.)

Key Words: cerebral venous thrombosis ■ incidence studies ■ stroke

The incidence of cerebral venous thrombosis (CVT) is estimated at 0.2 to 0.5 per 100 000 per year.1,2 One estimate was derived from an extrapolation of mortality and autopsy data from studies performed several decades ago.3 Kalbag and Woolf4 provide mortality figures from the British Registrar General. From 1952 to 1961 an average of 21.7 deaths from CVT were reported annually in a population of 56 million (0.39 deaths per million). The mortality of CVT probably varied between 20% and 50%. This gives an incidence of approximately 0.1 to 0.2 cases per 100 000. These indirectly calculated incidence rates are inaccurate, especially because improved neuroimaging has shown that, unlike previously believed, CVT often has a benign course. Other studies give estimates of 0.22,5 0.34,6 and 1.237 per 100 000, but in most of these studies, determination of the incidence was not the primary objective. We determined the incidence of CVT among adults in 2 provinces in The Netherlands over a 3-year period by hand-searching the medical records of all 19 hospitals in this region.

Patients and Methods

Study Design
We conducted a retrospective cross-sectional hospital-based population study among all 19 hospitals in the provinces of North-Holland and Flevoland. We searched for patients with CVT diagnosed between January 1, 2008, and December 31, 2010. First, we used the Dutch financial coding system for hospital care (DBC). The appropriate code for CVT is 1199, which includes infectious and noninfectious cases. Because in some instances patients might have been wrongly assigned the code 1111 “ischemic stroke” or 1102 “hemorrhagic stroke,” we also compiled lists of these codes. Because we expected that the yield of CVT cases among the latter codes would be low, and the fact that CVT is rare among elderly patients, we only searched these codes for patients up to the age of 65 years. In addition, we used the International Classification of Diseases, 9th Revision, used in 10 hospitals (codes 437.6, 325, 671.5, and 437.8).

Identification of CVT Cases
We hand-searched medical records of all patients with the appropriate DBC or International Classification of Diseases, 9th Revision codes. Only cases confirmed by MR venography, CT venography, conventional angiography, or autopsy were included. All cerebral imaging results were reassessed by the investigators (J.M.C. and S.M.Z.). If the diagnosis was judged incorrect, or found to be incorrect at follow-up, the patient was excluded. We also excluded patients who lived outside the 2 provinces. Extra care was taken to avoid duplicate counts.

Statistical Analysis
We acquired the population figures of the years 2008 to 2010 from the Dutch National Bureau for Statistics. To calculate the overall

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Results
We identified 9270 potential CVT cases (Figure). After hand-searching all medical records, we identified 147 patients diagnosed with CVT. Fifty-three patients did not meet the eligibility criteria; therefore, 94 patients were included in the analysis. The combined adult population of the 2 provinces was 2,353,429 in 2008, 2,379,236 in 2009, and 2,405,611 in 2010. The overall annual incidence of CVT among adults was 1.32 per 100,000 person-years (95% CI, 1.06–1.61; Table 1).
As expected, the incidence was significantly higher in women than men (1.86 versus 0.75) and higher among patients aged 31 to 50 years (1.71).
The median age of patients was 41 years (Table 2). Fifty-two percent of female patients used oral contraceptives and 18% were pregnant or had recently given birth. The transverse and sigmoid sinuses were thrombosed most often (70% and 53%, respectively). Parenchymal lesions at baseline occurred in 44%. Nearly all patients (96%) received anticoagulant treatment. Mortality was 1% at discharge and 3% at follow-up.

Discussion
We found an incidence of adult cerebral venous thrombosis of 1.32 per 100,000 person-years, much higher than previously published. This indicates that CVT in adults has an incidence comparable to bacterial meningitis.8 A possible explanation is that due to an increased awareness of CVT and improved imaging techniques, CVT is more frequently diagnosed. One of the strengths of our study is that we hand-searched the medical records of almost 10,000 potential CVT cases and used strict inclusion and diagnostic criteria. Because exact figures on population distribution are available in The Netherlands, we believe that our data provide a reliable estimate of the true incidence of CVT.
Several well-designed studies have examined the incidence of CVT among children. The Canadian Pediatric Ischemic Stroke Registry found an incidence of 0.67 per 100,000 per year with a peak among neonates.9 As a result, CVT was always believed to be more common among children than adults. In contrast, our data suggest that CVT is twice as common in adults as in children.
One previous study found an incidence similar to our study. Janghorbani et al7 performed a case registry in 2 hospitals in Iran and reported an incidence of 1.23 per 100,000. Their study, however, was performed in tertiary care hospitals, which may have caused referral bias. Furthermore, because recent data on population were lacking, they calculated their denominator based on an older census, which may be less accurate. Finally, it is unclear if they checked for duplicate counts or referrals from outside the caption area.
The mortality in our study, 1% at discharge and 3% at follow-up, is lower than in previous studies. In the International Study on Cerebral Vein and Dural Sinus Thrombosis (ISCVT), mortality was 4% at discharge and 8% at follow-up.10 This is in agreement with the idea that improved diagnosis has identified not only more cases, but also less severe cases with a benign course. Possibly, the almost

Table 1. Incidence Rates

<table>
<thead>
<tr>
<th>Population</th>
<th>Incidence Year⁻¹ 100,000⁻¹</th>
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<tbody>
<tr>
<td>Overall adult incidence</td>
<td>1.32 (1.06–1.61)</td>
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<tr>
<td>Subgroups</td>
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<tr>
<td>Women</td>
<td>1.86 (1.44–2.36)</td>
</tr>
<tr>
<td>Man</td>
<td>0.75 (0.49–1.09)</td>
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<tr>
<td>Age 18–30 y</td>
<td>1.64 (1.05–2.44)</td>
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<td>Age 31–50 y</td>
<td>1.71 (1.26–2.27)</td>
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<tr>
<td>Age ≥51 y</td>
<td>0.77 (0.48–1.16)</td>
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<tr>
<td>Women age 31–50 y</td>
<td>2.78 (1.98–3.82)</td>
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<tr>
<td>Men age 31–50 y</td>
<td>0.64 (0.29–1.21)</td>
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</tbody>
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Incidence rates are given per 100,000 person-years with 95% CIs in parentheses.

Table 2. Clinical and Radiological Manifestations

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<tr>
<td>Median age, y (range)</td>
<td>41 (18–72)</td>
</tr>
<tr>
<td>Sex, % female</td>
<td>72%</td>
</tr>
<tr>
<td>Oral contraceptive use, % of women</td>
<td>52%</td>
</tr>
<tr>
<td>Pregnancy or puerperium, % of women</td>
<td>18%</td>
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<tr>
<td>Parenchymal lesion</td>
<td>44%</td>
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<tr>
<td>Location thrombosis</td>
<td></td>
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<tr>
<td>Superior sagittal sinus</td>
<td>43%</td>
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<tr>
<td>Transverse sinus</td>
<td>70%</td>
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<tr>
<td>Sigmoid sinus</td>
<td>53%</td>
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<tr>
<td>Straight sinus</td>
<td>16%</td>
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<tr>
<td>Anticoagulation</td>
<td>96%</td>
</tr>
<tr>
<td>Mortality at discharge</td>
<td>1%</td>
</tr>
<tr>
<td>Mortality at follow-up</td>
<td>3%</td>
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</tbody>
</table>
universal application of anticoagulant treatment (96%) may have contributed to the low mortality.

Our study has several limitations. First, despite our extensive search, we cannot exclude that some cases have been missed. For instance, patients who were miscoded, who were admitted to a hospital outside the search region, or who were not treated by a neurologist would all have been missed. Thus, the incidence we found may be an underestimate of the true incidence. Another limitation is the retrospective design of our study, but because we manually checked the original medical records and imaging, we feel it is unlikely that this introduced bias.

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Disclosures
None.

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