Changing Rates of Stroke in the Province of Quebec, Canada: 1981–1988

Nancy E. Mayo, PhD; Mark S. Goldberg, MSc; Adrian R. Levy, BSc; Irena Danys, MD, FRCP(C); and Nicol Korner-Bitensky, MSc

Using more than 37,000 hospital discharges attributed to hemorrhagic or occlusive stroke in the province of Quebec, Canada, we analyzed trends in stroke incidence during the period 1981–1988. There were large and statistically significant (p<0.05) increases in the rates of hemorrhagic stroke over this period. Dramatic increases occurred among men in the rates of both intracerebral (International Classification of Diseases-Ninth Revision [ICD9] code 431) and intracranial (ICD9 code 432) hemorrhagic strokes (40–204% depending on age). In contrast, the rates of occlusion of the precerebral arteries (ICD9 code 433) declined in younger men and women but increased substantially (107%) in older men. Rates of occlusion of the cerebral arteries (ICD9 code 434) declined in men over the age of 50 years and in women aged 50–79 years. Despite the decline in the rate of occlusion of the cerebral arteries, the rate of hemorrhagic stroke appears to have increased. Changes in the hospitalization rates for hemorrhagic stroke were not accompanied by consistent decreases in the case-fatality rate. This finding tends to support the hypothesis of an actual increase in the hospitalization rate for hemorrhagic stroke rather than an artifactually elevated rate due to enhanced diagnosis by computed tomography. (Stroke 1991;22:590–595)

From 1945 to 1980, the decline in stroke incidence in the United States was attributed to modifications in the major risk factors for stroke, particularly to improvements in the control of hypertension.1–3 Recently, however, three papers have reported an increase in the rate of stroke.4–6 One report from Rochester, Minnesota, found that the incidence of stroke was 17% higher for the period 1980–1984 than for the period 1975–1979.7 The National Hospital Discharge Survey4 from the United States reported a similar increase in the hospitalization rate for stroke over the period 1979–1983. Neither study could rule out the possibility that the increases were artifactual due to changes in the admission rates for cerebral angiography and endarterectomy or to changes in the use of computed tomography, a procedure that presumably has improved the detection of mild strokes. A study from Sweden found a significant increase in the incidence of stroke among women for the period 1983–1986 compared with the period 1975–1978; however, no specific mechanism contributing to this increase was identified. The rise was probably not due to changes in diagnostic practice favoring the detection of milder strokes because the case-fatality rates were stable over this period.

To investigate the possibility of a similar increase in the incidence of stroke in the province of Quebec, we conducted a survey of hospital discharges attributed to stroke for the period 1981–1988.

Subjects and Methods

We obtained the data for this study from a province-wide data base of hospital discharges, referred to as Med-Echo,9 for the 8 fiscal years (April through March) 1981–1988, inclusive. Since 1981, all acute-care hospitals and, since 1985, all other hospitals within the province of Quebec have reported to the Med-Echo system. Each hospital reporting to this system is responsible for the abstraction, coding, and verification of its own data. Diagnoses at discharge are coded according to the International Classification of Disease, Ninth Revision (ICD9). The data are then entered electronically at a central location and are checked for internal consistency.

In addition to discharge diagnoses and geographic, demographic, and medical information, the Med-Echo data base contains information identifying the discharge hospital and whether it is an acute-care hospital or a long-term care facility. Discharges from
FIGURE 1. Rates of discharge for hemorrhagic stroke (International Classification of Diseases–Ninth Revision code 430, subarachnoid, ○; 431, intracerebral, □; 432, intracranial, ▽) in province of Quebec from 1981 to 1988 for eight age- and sex-specific groups. Left column, men; right column, women; top row, aged 15–49 years; second row, aged 50–64 years; third row, aged 65–79 years; bottom row, aged ≥80 years.
FIGURE 2. Rates of discharge for occlusive stroke (International Classification of Diseases–Ninth Revision code 433, precerebral, ○; 434, cerebral, □) in province of Quebec from 1981 to 1988 for eight age- and sex-specific groups. Left column, men; right column, women; top row, aged 15–49 years; second row, aged 50–64 years; third row, aged 65–79 years; bottom row, aged ≥80 years.
Results

From 1981 to 1988, there was a total of 79,482 stroke discharges in the province of Quebec; 4,286 were coded as ICD9 code 430, 4,935 as ICD9 code 431, 1,915 as ICD9 code 432, 10,025 as ICD9 code 433, and 15,862 as ICD9 code 434. The remaining 42,449 strokes were coded as ICD9 codes 436 or 437 and are not dealt with in this paper, but information on these rates may be obtained from the authors. Age- and sex-specific annual rates are presented for hemorrhagic strokes (ICD9 codes 430, 431, and 432) in Figure 1 and occlusive strokes (ICD codes 433 and 434) in Figure 2.

The annual rates for ICD9 code 430 did not change significantly over time. Those for ICD9 code 431 increased significantly, by approximately 50% among men aged 50–64 and 65–79 years and by 128% among men aged 80 years and older. Among women the annual rates for ICD9 code 431 increased significantly only in the two oldest age groups: 38% for those aged 65–79 years and 84% for those aged 80 years and older. The annual rates for ICD9 code 432 increased significantly only among men: 40% for those aged 65–79 years and 204% for those aged 80 years and older.

The annual rates for ICD9 code 433 declined significantly for men in the two youngest age groups and increased significantly in the two oldest age groups. This increase was slight among men aged 65–79 years (10%) but was substantial among men aged 80 years and older (107%). The annual rates for ICD9 code 434 declined significantly for men of all ages except those aged 15–49 years. The annual rates for occlusion of cerebral arteries (ICD9 code 434) declined significantly among middle-aged women but did not change among the youngest or the oldest women.

A significant threefold increase over the 8-year period in the 30-day case-fatality rate for ICD9 code 430 was observed for women aged 80 years and older; otherwise, the 30-day case-fatality rates did not change significantly. There were marked differences in the 30-day case-fatality rates between ICD9 codes 431 and 432. The case-fatality rates for ICD9 code 431 averaged 49%, more than twice the average for ICD9 code 432. The case-fatality rates for ICD9 code 431 declined significantly for men aged 15–49 years (57%) and for both men and women aged...
would expect to see an increase in the proportion of individuals who were able to return to their homes.  

The case-fatality rates for the two types of occlusive stroke differed: persons discharged with ICD9 code 433 had, on average, lower 30-day case fatality rates (7.5%) than did persons discharged with ICD9 code 434 (15%). The case-fatality rates for ICD9 code 434 declined significantly (approximately 37%) over the 8 years of study among men in the two oldest age strata (i.e., those aged 65-79 years or 80 years and older).

The proportion of survivors discharged home ranged from 19% to 80% for persons with intracerebral or intracranial hemorrhagic strokes (ICD9 code 431 or 432) and from 47% to 95% for persons with occlusive strokes. No consistent pattern to the changes in these proportions over time was evident.

Discussion

There were rather large and statistically significant ($p<0.05$) increases in the annual rates for hemorrhagic stroke observed over the period 1981-1988. Dramatic increases were observed for both intracerebral (ICD9 code 431) and intracranial (ICD9 code 432) hemorrhagic strokes. In contrast, the annual rates for occlusion of the precerebral arteries (ICD9 code 433) declined in younger men and women but increased substantially in older men; rates for occlusion of the cerebral arteries (ICD9 code 434) declined in both men and women.

Are the substantial increases in the annual rates for intracerebral and intracranial hemorrhagic strokes fact or artifact? Statistical variation could be an explanation for the increased rate of hospital discharge, although this is unlikely as we observed a strong linear relation by year.

Changes in the reporting of specific types of strokes over time could also account for the changes, and the increased use of computed tomography could have resulted in enhanced detection of hemorrhagic strokes and cerebral infarcts.11 The two recent papers that reported a rise in the incidence of stroke5,6 attributed the increase, at least in part, to the introduction of computed tomography, a procedure that presumably has improved the detection of mild strokes.

To investigate the possibility that the severity of the strokes decreased over time, 30-day case-fatality rates were examined as a proxy for severity. The increase in the hospitalization rate for intracerebral hemorrhagic strokes was accompanied by a decline in the 30-day case-fatality rate, but the increase in the hospitalization rate for intracranial hemorrhagic strokes was not.

To aid in the interpretation of changes in the severity of stroke, we also examined the proportions of survivors discharged home. If, over time, there was an increase in the number of milder strokes, then we would expect to see an increase in the proportion of individuals who were able to return to their homes. In fact, the declines in case-fatality rates were not accompanied by any consistent increases in the proportion of survivors discharged home. This finding tends to support the hypothesis of a true increase in the hospitalization rate for hemorrhagic strokes rather than an artifactually elevated rate due to enhanced diagnoses of mild hemorrhagic strokes.

Enhanced detection could be a viable explanation for the changes observed in the annual rates for occlusion of the precerebral arteries. In particular, the substantial increase in the rate among men aged 80 years and older could be attributed, in part, to the increased availability and refinement of vascular evaluation through the use of noninvasive Doppler ultrasound. Previously, stroke patients in this age group may not have been assessed fully due to the risk of invasive diagnostic procedures.

Hospital discharge data consistently underestimate incidence, primarily because cases not hospitalized are not ascertained.2,12 For stroke, the extent to which hospital discharge data underestimates incidence is minimal13 because sudden death occurs in <10% of strokes14 and almost all completed strokes, especially under Canada's universal health care system, are admitted to a hospital.14,15

Another source of error in estimating incidence is that persons who had more than one stroke discharge during the study period cannot be distinguished from persons who had only one stroke discharge.7 In addition, the accuracy of the diagnostic codes is not assured and coding practices may vary from one hospital to another. Such diagnostic misclassification, if random, would probably tend to attenuate the rates. Overall, however, it is likely that any trends in incidence will be reflected in the patterns of hospital discharge.

Despite a number of limitations, hospital discharge data, especially under a universal health care system such as in Canada, are a valuable source of information to monitor trends and to plan health care requirements.

While some factors could have artifactually changed the rates of particular types of stroke over time, we feel that there is evidence from this study pointing to actual increases in the annual rates of hemorrhagic stroke in the province of Quebec during this last decade perhaps due to previously unexplored etiologic mechanisms.

References


KEY WORDS • cerebrovascular disorders • epidemiology • incidence • Canada
N E Mayo, M S Goldberg, A R Levy, I Danys and N Korner-Bitensky

Stroke. 1991;22:590-595
doi: 10.1161/01.STR.22.5.590

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/22/5/590