Sex Differences in Stroke Care and Outcomes
Results From the Registry of the Canadian Stroke Network

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Background—Stroke is an important cause of death and disability in women as well as men. However, little is known about sex differences in stroke care and outcomes.

Methods—The Registry of the Canadian Stroke Network (RCSN) captured data on patients with stroke seen at acute care hospitals across Canada. We used data from phase 1 (July 2001 to February 2002) and phase 2 (June to December 2002) of the RCSN to compare stroke presentation, management, and 6-month outcomes in women and men using multivariable regression techniques to adjust for age and other factors.

Results—The study sample included 3323 patients, with 1527 women. Stroke symptoms at presentation were similar in women and men, except that women were more likely to present with headaches and were less likely to have brain stem or cerebellar symptoms. There were no sex differences in the use of neuroimaging, thrombolysis, antithrombotic therapy, or consultations. Women were less likely than men to receive care on an acute stroke unit, but this difference was no longer significant after adjustment for age and other factors. Women were more likely than men to be discharged to long-term care and had greater disability at 6 months. Mortality and quality of life at 6 months were similar in women and men.

Conclusions—Among patients participating in the RCSN, there were no major sex differences in stroke presentation or management. Compared with men, women were more often institutionalized and had a slightly worse functional status at 6 months after stroke. (***Stroke*. 2005;36:809-814.)**

Key Words: registries ■ stroke ■ women's health

Stroke is a leading cause of death and disability in industrialized countries and is common in women and men.[1] Women have a lower lifetime risk of stroke than men, however, because women are over-represented in the older age groups and because stroke mortality is higher with older age, women have a greater risk of dying from stroke. For example, in Canada in 1995, stroke accounted for 8951 deaths in women and 6586 deaths in men.[2]

Numerous studies have documented sex differences in the presentation, management, and outcomes of patients with coronary artery disease. For example, compared with men, women with symptoms of coronary artery disease experience more atypical pain, are less likely to be referred for diagnostic testing, and may have higher mortality from coronary artery bypass surgery, although this may not be sustained long term.[3–5] Although there is little published information on sex differences in stroke presentation and management, recent studies from Sweden and Europe have found differences in stroke symptoms and comorbid illness on presentation, lower use of some in-hospital investigations, and increased disability at 3 months after stroke in women.[6–8] It is not known whether such differences exist in a North American setting nor whether women are less likely to receive interventions such as thrombolysis or care on an acute stroke unit.

We used data from the Registry of the Canadian Stroke Network (RCSN) to determine whether women and men with stroke were equally likely to receive evidence-based therapies for stroke, including thrombolysis, care on acute stroke unit, antithrombotic therapy, and warfarin for atrial fibrillation. We also compared in-hospital and 6-month outcomes in women and men.

Methods

The RCSN collects data on patients with acute stroke seen at selected acute care hospitals across Canada.[9] Phase 1 of the RCSN took place

Received November 1, 2004; final revision received December 20, 2004; accepted December 24, 2004.

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The results and conclusions are those of the authors and should not be attributed to any of the sponsoring or funding agencies.

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***Stroke* is available at http://www.strokeaha.org** **DOI: 10.1161/01.STR.0000157662.09551.e5**

between July 2001 and February 2002 and included 21 urban tertiary care centers with specialized stroke care expertise and resources: all had a neurologist with expertise in stroke, 81% were teaching hospitals, and 57% had an acute stroke ward. After a hiatus in patient recruitment to permit completion of follow-up interviews and data collection, phase 2 took place between June and December 2002 and included the 21 original sites as well as 4 large community hospitals. The study was approved by the research ethics board at each participating site, and patient or surrogate written informed consent was obtained before data collection. Trained neurology research nurses recruited consecutive patients with acute stroke or transient ischemic attack and performed data entry on the basis of chart reviews and patient and family interviews.

Follow-up telephone interviews were attempted at 6 months after the index stroke admission on all patients surviving to discharge, regardless of discharge destination. During follow-up interviews, data were collected on survival, functional status, and quality of life. Functional status was measured using the Stroke Impact Scale-16 (SIS-16), which is derived from the SIS and is designed to measure physical functioning.[10,11] The SIS has well-validated psychometric properties and includes a physical domain (comprised of 4 component domains of strength, hand function, mobility, and activities of daily living) as well as the domains of emotion, memory, communication, and social participation. The SIS-16 includes 16 questions from the SIS physical domain. Each question is rated on a scale of 1 (could not do at all) to 5 (not difficult at all), and the combined scores are transformed to a score from 0 (worst) to 100 (best). A difference of 10 to 15 points on the SIS-16 is considered clinically significant and correlates with a difference of 1 point in the modified Rankin scale.[12] The SIS has been validated for proxy and telephone administration.[13] Quality of life was measured using the Health Utilities Index (HUI) Mark 2/3, which provides a single-summary score of health-related quality of life, where a score of 0.00 indicates death and 1.00 indicates perfect health; negative scores (to a minimum of −0.36) are permitted to indicate health states considered worse than death.[11] It includes questions related to the attributes of vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain. The HUI has been shown to be reliable, valid, and responsive to change, with differences in overall HUI scores of ≥0.03 considered clinically significant.[14]

We combined data from phases 1 and 2 of the registry and compared baseline demographics and stroke symptoms in women and men. We used χ^2 tests to compare the proportion of women and men who received care on an acute stroke unit and the proportion of women and men with ischemic stroke who received thrombolysis and antithrombotic agents. We used multiple logistic regression to adjust for age, stroke type (ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, or undefined stroke), stroke severity (as measured by the Canadian Neurological Scale [CNS] score), level of consciousness, comorbid illness (as measured by the Charlson comorbidity index score), marital status, and living situation.[15,16] Because patient recruitment varied among study sites, the RCSN participation rate at each study center was included as a continuous variable in the modeling. Secondary analyses compared the proportion of women and men who underwent neuroimaging (computed tomography or MRI) and carotid imaging (Doppler ultrasound, catheter angiography, or magnetic resonance angiography) and who received inpatient consultations from occupational therapists, physiotherapists, speech-language pathologists, and neurologists. Other outcomes included in-hospital mortality and complications, length of stay, discharge destination, functional status at discharge (measured by the modified Rankin score), and 6-month mortality, SIS-16 scores, and HUI 2/3 scores. For SIS-16 scores, we used general linear modeling to compare outcomes in women and men with adjustment for age, comorbid illness, stroke type, and stroke severity. Cases missing data for the variable of interest were excluded from the analyses. SAS (version 8.02) was used for all analyses.

Results

During the study time frame, 7670 patients were seen at participating hospitals, and 3329 consented to full data collection. Data on sex were not available for 6 patients, leaving a total of 3323 patients (1527 women and 1796 men) for the current analyses. All but 58 patients were recruited from tertiary care centers. Some patients had >1 stroke; however, we analyzed only the first stroke event for each patient. Compared with men, women were older (median age of 73 versus 69 years; $P<0.0001$) and were more likely to live alone, to be widowed, and to have a history of hypertension or dementia; men were more likely than women to have a history of smoking, diabetes mellitus, hyperlipidemia, myocardial infarction, previous stroke, or to have a Charlson comorbidity index score >1 (indicating a higher burden of comorbid illness; Table 1). Women were more likely than men to have subarachnoid hemorrhage and less likely to have posterior circulation stroke according to the Oxfordshire Community Stroke Project (OCSP) classification system. There were no significant sex differences in level of consciousness or whether the stroke symptoms were first noted on awakening. The most common presenting symptoms were weakness in 68%, sensory symptoms in 36%, aphasia in 26%, headache in 26%, and brain stem or cerebellar symptoms in 22%. Presenting symptoms were similar in women and men except that men were more likely to present with brain stem or cerebellar symptoms and less likely to present with headache. Headache was more common in women, even after adjustment for age, comorbidity, level of consciousness, and stroke type. Stroke severity, as measured by the CNS,[17] was similar in women and men (Table 1).

Women and men were equally likely to be transported to hospital by ambulance, to arrive in the emergency department within 2 hours of stroke onset, and to have neuroimaging performed within 25 minutes of hospital arrival (Table 2). Women and men with ischemic stroke were equally likely to receive thrombolysis, even after adjustment for age and other risk factors (Table 2; also see Table 4). Women and men were equally likely to receive in-hospital assessments from occupational therapists, physiotherapists, social workers, and neurologists, although we did not examine the frequency or intensity of assessments. Women were less likely than men to receive care on an acute stroke unit (18% versus 21%; $P=0.0232$); however, this was no longer significant after adjustment for age, comorbidity, and other factors (adjusted odds ratio [OR], 0.940; 95% CI, 0.737 to 1.199; $P=0.6189$; see Table 4). Use of investigations, including neuroimaging, carotid imaging, and echocardiography, was similar in women and men; however, women were less likely to have lipids measured (Table 2). At discharge, women and men with ischemic stroke were equally likely to receive antithrombotic agents, including warfarin, for atrial fibrillation (Table 2).

The risk of in-hospital complications, including death, was similar in women and men, except that men were slightly more likely to develop pneumonia (Table 3). Women had a slightly longer median length of stay than men (11 versus 10 days; $P=0.0108$) and were more likely than men to be

TABLE 1. Baseline Data for Women and Men in the RCSN

	Total	Women	Men	*P* Value
No.	3323	1527	1796	
Age, median (years)	71	73	69	<0.0001
Lives alone, %	23	32	15	<0.0001
Widowed, %	18	31	7	<0.0001
Medical history				
Previous stroke, %	20	18	21	0.0191
Diabetes mellitus, %	22	20	24	0.0068
Hypertension, %	58	60	57	0.0498
Smoking (current), %	19	16	22	0.0004
Hyperlipidemia, %	30	26	34	<0.0001
Atrial fibrillation, %	14	15	12	0.0456
Myocardial infarction, %	14	10	18	<0.0001
Dementia, %	3	4	2	0.0294
Charlson comorbidity index score >1, %*	26	24	28	0.0146
Independent before admission, %	89	87	92	0.0127
Stroke type, %				<0.0001
Ischemic	78	74	81	
Intracerebral hemorrhage	11	11	11	
Subarachnoid hemorrhage	8	12	5	
Unable to determine	2	2	3	
OCSP classification for ischemic events, %				0.0743
Lacunar	20	21	19	
Partial anterior circulation	37	39	36	
Total anterior circulation	13	14	13	
Posterior circulation	23	20	26	
Transient ischemic attack	4	4	4	
Other	3	3	3	
Unconscious at presentation, %	6	7	6	0.1263
CNS score on presentation, median	9.5	9.5	9.5	0.3360
Brain stem or cerebellar symptoms, %	22	19	25	0.0001
Headache, %	26	31	22	0.0001
Weakness, %	68	67	70	0.1240
Aphasia, %	26	26	26	0.6014
Sensory symptoms, %	36	35	37	0.4562

*Charlson comorbidity index scores >1 indicate greater comorbid illness.

discharged to long-term care or a nursing home (10% versus 5%; $P<0.0001$), even after adjustment for age, comorbidity, and other risk factors (adjusted OR, 1.753; 95% CI, 1.129 to 2.719; $P=0.0123$; Tables 3 and 4). Although the median Rankin score at discharge was similar in women and men, there was a trend toward a higher proportion of women with severe disability (Rankin score of 4 or 5) at discharge (30% versus 26%; $P=0.0911$).

Six-month follow-up data were available for 2790 patients. There was no difference in sex or stroke type among those with and without follow-up interviews; however, those lost to follow-up were slightly younger and were less likely to have been alert at the time of stroke onset. Six-month mortality was similar in women and men (14% versus 12%; $P=0.1897$), as was quality of life as measured by the HUI 2/3, with a median score of 0.9 for women and men. The median SIS-16 score was slightly lower in women (85.9 versus 92.2; $P=0.0001$; Table 3), and this was significant even after adjustment for age and stroke type.

Discussion

We found that women with stroke were slightly older than men, had a slightly longer length of stay, were more likely to be discharged to long-term care, and had slightly worse functional status at 6 months after stroke. However, we found no striking sex differences in stroke presentation or severity, in-hospital management, or 6-month mortality or quality of life.

The findings of sex differences in demographics, length of stay, and discharge destination after stroke admission are consistent with previous studies, which have shown that women with stroke tend to be older and less likely to have

TABLE 2. Stroke Management in Women and Men in RCSN

	Total	Women	Men	*P* Value
No.	3323	1527	1796	
Transported by ambulance, %	59	60	58	0.2084
Arrival in emergency department within 2 hours of stroke onset, %	27	26	28	0.1684
Neuroimaging within 25 minutes of emergency department arrival, %	8	7	9	0.1824
Thrombolysis given*, %	11%	10%	11%	0.3743
No. admitted to hospital	2924	1345	1579	
Admitted to stroke unit, %	20	18	21	0.0232
Admitted to stroke unit or seen by stroke team, %	40	37	42	0.0207
Occupational therapy assessment, %	65	65	65	0.7773
Physiotherapy assessment, %	69	68	70	0.3024
Speech language pathology assessment, %	44	41	46	0.0254
Social work assessment, %	40	40	39	0.4385
Neurology assessment, %	92	92	93	0.3507
Antithrombotic therapy at discharge*, %	92	91	92	0.5863
Warfarin for atrial fibrillation*, %	72	72	72	0.9714
Lipid measurement*, %	62	59	64	0.0148
Carotid imaging*, %	76	76	77	0.5512
Echocardiography*, %	56	57	56	0.6009
Holter monitoring*, %	22	23	20	0.1813

*Analysis limited to patients with ischemic stroke.

social supports than their male counterparts.[18] However, our findings differ from recent publications from other stroke databases, which have documented sex differences in stroke presentation, with an increased frequency of symptoms such as aphasia and dysphagia in women.[6,7] Previous studies have also suggested lower use of investigations and therapies in women, including lower use of computed tomography, carotid imaging, and antithrombotic agents.[6,7,19] The discrepant findings among different studies may reflect differences in the study populations or variations in practice patterns among jurisdictions. For example, we had few patients >85 years of age, a subgroup in which management has been shown to differ in women and men,[19] and our participating institutions were primarily tertiary care hospitals with specialized stroke care resources and expertise, in which stroke care delivery patterns may not reflect general practice in Canada.

The most common presenting symptoms for women and men were weakness, sensory symptoms, brain stem or cerebellar symptoms such as vertigo, and headache, which are consistent with the stroke warning signs taught in public awareness campaigns by organizations such as the Heart and Stroke Foundation of Canada and the American Stroke Association. This suggests that the current public education initiatives are appropriate for women and men. However, health care providers should be aware of the higher frequency of headache as a presenting symptom in women, related in

TABLE 3. Stroke Outcomes in Women and Men in RCSN

	Total	Women	Men	*P* Value
No. admitted to hospital	2924	1345	1579	
Thromboembolic event, %	2	3	2	0.2977
Decubitus ulcer, %	1	1	2	0.7368
Pneumonia, %	6	4	7	0.0044
Depression, %	4	4	4	0.6147
Median length of stay, days	10	11	10	0.0108
In-hospital mortality, %	7	8	7	0.1974
Discharge Rankin score 4 or 5, %	28	30	26	0.0911
Discharge to long-term care, %	7	10	5	0.0001
6-month mortality, %	13	14	12	0.1897
SIS-16 score at 6 months, median	90.6	85.9	92.2	0.0001
HUI score at 6 months, median	0.9	0.9	0.9	0.1307

TABLE 4. Multivariate Analysis of Stroke Management and Outcomes in Women and Men

Variable	Adjusted OR* (Women vs Men)	95% CI	*P* Value
Thrombolysis†	0.887	0.641 to 1.228	0.4696
Antithrombotic therapy at discharge†	0.852	0.580 to 1.251	0.4145
Care on an acute stroke unit	0.940	0.737 to 1.199	0.6189
Discharge to long-term care or nursing home	1.753	1.129 to 2.719	0.0123
In-hospital mortality	1.012	0.677 to 1.514	0.9529

*Adjusted for age, Charlson comorbidity index score, level of consciousness, stroke type, CNS score, hospital consent rate, marital status, and living situation.

†Analysis limited to patients with ischemic stroke.

part to the higher frequency of subarachnoid hemorrhage as the cause of stroke in women.

Despite a similar stroke severity on presentation, as measured by the CNS, and a similar Rankin score at discharge, women stayed in hospital on average 1 day longer than men and were more likely to be discharged to long-term care. This is consistent with previous studies and is likely explained by a poorer preadmission functional status in women (women were slightly less likely than men to be completely independent before admission) and fewer social supports, with more women than men being widowed and living alone. In addition, women may have more disability after stroke: although the median Rankin score at discharge was similar in women and men, there was a trend toward a higher proportion of women with severe disability at discharge. Although mortality and quality of life were similar in women and men at 6 months after stroke, women had a slightly worse functional status, as measured by the SIS-16, with a median score that was 6.3 points lower than that of men. This difference corresponds to ≈0.5 points on the Rankin scale, a difference that may not be clinically significant for an individual patient but that is likely to be relevant at a population level.[12]

This study has a number of limitations. First, patient or surrogate consent was required for participation in the RCSN, which resulted in the exclusion of some patients with severe or fatal stroke who were unable to give consent, as well as those with minor stroke or transient ischemic attack who were discharged before they could be approached by the study coordinator. [20] Thus, the results of our study are generalizable mainly to the subgroup of patients with moderate severity strokes. Although overall consent rates were similar in women and men, it is possible that there were differences in the characteristics of men and women who did not consent to data collection (for example, women may have been overrepresented in the older patients with more severe strokes), and there may have been sex differences in the management and outcomes of this subgroup of patients that were not captured in this study. Second, participating hospitals were primarily tertiary care institutions with specific stroke care expertise and resources, and the care provided to women and men at these sites may not be representative of stroke care delivery at other types of institutions. However, administrative data show that ≈20% of all Canadian stroke patients are admitted to these institutions (J.V. Tu, unpublished data, 2002), suggesting that our results are applicable to a substantial proportion of the population. In addition, although stroke care in general is likely to be different in institutions that did and did not participate in the RCSN, there is no specific reason to suspect that care for women would be systematically different at different types of institutions. Finally, we do not have detailed information on interventions such as the type of rehabilitation provided or other outcomes such as patient satisfaction.

In summary, we found that stroke presentation and management were similar in women and men participating in the RCSN. However, the longer length of stay and greater disability in women confirm the personal and societal burden of stroke in this population. Future research should focus on exploring reasons for and potential solutions to these differences in outcomes.

Appendix

The following persons and institutions participated in the RCSN.

Queen Elizabeth II Health Sciences Centre, Halifax, NS

S. Phillips, MD (principal investigator), G. Gubitz, MD (principal investigator), W. Simpkin, RN (coordinator).

Saint John Regional Hospital, St. John, NB

P. Bailey, MD (principal investigator), P. Cook, RN (coordinator), Shelly Allward, RN (coordinator).

Hôpital Notre-Dame du CHUM, Montreal, QC

L.H. Lebrun, MD (principal investigator), M.P, Desrochers, RN (coordinator), L. Mercille, RN (coordinator).

Hôpital de l'Enfant-Jesus, Quebec City, QC

D. Simard, MD (principal investigator), A. Mackey, MD (principal investigator), S. Dube, RN (coordinator), B. Leger, RN (coordinator), A. Hache, RN (coordinator).

Hôpital Charles le Moyne, Greenfield Park, QC

L. Berger, MD (principal investigator), L. Moisan, RN (coordinator), Y. Serraspino, RN (coordinator), D. Truong, RN (coordinator)

Montreal General Hospital and SMBD-Jewish General Hospital, Montreal, QC

R. Cote, MD (principal investigator), J. Minuk, MD (principal investigator), C. Wong, RN (coordinator).

Sunnybrook and Women's College Health Sciences Centre, Toronto, ON

S. Black, MD (principal investigator), N. Jiang (coordinator), J. Bray (coordinator), M. Kerr-Taylor, RN (coordinator).

University Health Network/Toronto Western Hospital, Toronto, ON

F. Silver, MD (principal investigator), P. Urzua, RN (coordinator), G. Gutierrez, RN (coordinator), R. Wiegner, RN (coordinator).

London Health Sciences Centre, London, ON

V. Hachinski, MD (principal investigator), N. Absolon, RN (coordinator), L. Cotton, RN (coordinator).

The Ottawa Hospital, Ottawa, ON

A. Douen, MD (principal investigator), M. Sharma, MD (principal investigator), N. Pageau, RN (coordinator), M. Savage, RN (coordinator).

Kingston General Hospital, Kingston, ON

D. Howse, MD (principal investigator), D. Brunet, MD (principal investigator), S. Weatherby, RN (coordinator).

Hamilton Health Sciences Centre, Hamilton, ON

W. Oczkowski, MD (principal investigator), N. Pyette, RN (coordinator), L. Gould, RPN (coordinator).

Trillium Health Sciences Centre, Mississauga, ON

D. Selchen, MD (principal investigator), H. Hinks, RN (coordinator), T. Stokes, RN (coordinator).

Winnipeg Regional Health Authority, Winnipeg, MB

B. Anderson, MD (principal investigator), D. Gladish, RN (coordinator), A. Gousseau, RN (coordinator), P. Pikl, RN (coordinator).

Royal University Hospital, Saskatoon, SK

C. Voll, MD (principal investigator), S. Bishop, RN (coordinator), L. Schmidt, RN (coordinator), B. Kwiatkowski, RN (coordinator).

Foothills Medical Centre, Calgary, AB

M. Hill, MD (principal investigator), L. Sinclair, RN (coordinator), M. Schebel, RN (coordinator), A. Cole-Haskayne, RN (coordinator).

University of Alberta Hospital, Edmonton, AB

A. Shuaib, MD (principal investigator), A. Nasser, RN (coordinator).

Lions Gate Hospital, North Vancouver, BC

D. Cameron, MD (principal investigator), C. Tadey, RN (coordinator).

Vancouver General Hospital, Vancouver, BC

P. Teal, MD (principal investigator), T. Steele, BSN, RN (coordinator).

St. Paul's Hospital, Vancouver, BC

D. Johnston, MD (principal investigator), M. Wong, MD (principal investigator), H. Connolly, RN (coordinator).

Capital Health Region, Victoria, BC

A. Penn, MD (principal investigator), M. Laporte, RN (coordinator).

Acknowledgments

This work was funded by an operating grant from the Heart and Stroke Foundation of Ontario (NA 4909). The Registry of the Canadian Stroke Network was funded by the Canadian Stroke Network. Data collection in Ontario institutions was funded in part by the Ontario Ministry of Health and Long-Term Care. The Institute for Clinical Evaluative Sciences is supported by an operating grant from the Ontario Ministry of Health and Long-Term Care. M.K.K. is supported by a scholarship from the Canadian Stroke Network and the Women's Health Program at the University Health Network. M.D.H. is supported by a scholarship from the Canadian Institutes of Health Research and Heart and Stroke Foundation of Alberta/Northwest Territories/Nunavut. The authors thank the hospitals, investigators, and research coordinators who participated in the Registry of the Canadian Stroke Network, as well as the many staff at the Institute for Clinical Evaluative Sciences and the Canadian Stroke Network who assisted in the coordination of the registry. The full list of investigators in the Registry of the Canadian Stroke Network is shown in the Appendix.

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Stroke. 2005;36:809-814; originally published online February 24, 2005;
doi: 10.1161/01.STR.0000157662.09551.e5
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0039-2499. Online ISSN: 1524-4628