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ABSTRACT

Objective: To describe clinical characteristics and evaluate processes of care and outcomes at discharge in patients with ischemic stroke with and without preexisting dementia.

Methods: Retrospective cohort study using the Registry of the Canadian Stroke Network including patients presenting with an acute ischemic stroke between 2003 and 2008. Preexisting dementia was defined as any type of dementia that was present prior to the index stroke case. Palliative patients were excluded. Demographic information, clinical presentation, selected process measures (e.g., thrombolysis, admission to stroke unit, carotid imaging, stroke prevention), pneumonia, death, disability, and disposition at discharge were analyzed.

Results: Among 9,304 eligible patients with an acute ischemic stroke, 702 (9.1%) had a history of dementia. Patients with dementia were older (mean age 81 vs 70 years; $p < 0.001$), had more severe strokes (Canadian Neurological Scale score <4, 20.7% vs 10.5%; $p < 0.001$), and were more likely to have atrial fibrillation (22.8% vs 15.3%; $p < 0.001$) than those without dementia. Patients with dementia were slightly less likely to be admitted to a stroke unit (63% vs 67.6%; odds ratio [OR] 0.82, 95% confidence interval [CI] 0.70–0.96) or to receive thrombolysis (10.5% vs 15.7%; OR 0.63, 95% CI 0.49–0.81). There were no differences in other performance measures. Patients with preexisting dementia had higher disability at discharge (OR 3.20, 95% CI 2.64–3.87) and were less likely to be discharged to their prestroke place of residence (24% vs 45%; $p < 0.001$).

Conclusions: In patients with stroke, preexisting dementia is associated with high rates of disability and institutionalization, representing an increasing challenge for the health care system. *Neurology*® 2011;77:1664–1673

GLOSSARY

CI = confidence interval; **DAD** = Discharge Abstract Database; **mRS** = modified Rankin Scale; **OR** = odds ratio; **RCSN** = Registry of the Canadian Stroke Network.

Stroke is a devastating medical condition for patients and their families. The risk of stroke and dementia both increase with age; in the Canadian Study of Health and Aging, for example, the prevalence of dementia rose from 8% of those over 65 to 33% at age 85.[1] With current aging demographics, an increase in the prevalence of stroke and dementia is expected, both alone and in combination.[2] Consequently, a greater number of health professionals will likely face the challenge of managing patients presenting with an acute stroke and concomitant dementia. For example, in Canada, during the 2003–2004 fiscal year, over 70% of hospitalized stroke patients were 70 years of age or older with an annual cost of $3.6 billion a year in physician

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Supplemental data at www.neurology.org

Supplemental Data

CME

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services, hospital costs, lost wages, and decreased productivity.[3,4] The economic burden is particularly high for patients with dementia, with recent estimates from the Alzheimer Society of Canada being $15 billion per year.[5,6] Recent studies support the effectiveness of organized stroke care (i.e., stroke unit admission, use of thrombolysis) in reducing stroke morbidity and mortality irrespective of age, stroke severity, and subtype.[7–9] However, it is not clear whether that benefit extends to patients with dementia.

Different paradigms of care for patients with acute stroke and preexisting dementia (comprehensive assessment vs practical approach) have been under intense debate.[10,11] Access to high-quality stroke care is regarded as a valued principle in maintaining equity for most persons, but in older patients with preexisting dementia, sometimes there may be an inclination to minimize interventions unless these are likely to improve outcomes.[12–15] For example, in some countries, there are limitations in access to specialized care for patients with dementia (e.g., access to coronary care units for patients with myocardial infarction, brain imaging for patients with acute stroke, antibiotic treatment for pneumonia or tube feeding).[10,15–17]

Unfortunately, there is limited information on access to care and process measures in stroke patients with preexisting dementia.

Our purpose was 1) to provide a description of demographic, clinical presentation, and disability at discharge; and 2) to evaluate access to care and performance measures among patients presenting to tertiary care centers with an acute ischemic stroke with and without preexisting dementia.

METHODS

We conducted a retrospective observational study using the Registry of the Canadian Stroke Network (RCSN), a clinical database including patients who have experienced an acute stroke admitted to the participating institutions. Since its inception in 2001, an important goal of the RCSN has been to measure and monitor the quality of hospital-based stroke care delivery.[18]

Participants were eligible if they were admitted to any of 12 regional stroke centers in the province of Ontario (Canada) with a first acute ischemic stroke between July 2003 and September 2008. Patients with TIA or hemorrhagic strokes were not included in this study as they have different underlying mechanisms, risk factors, and prognosis. Palliative patients (n = 1,354; 264 with preexisting dementia and 1,090 without dementia) were excluded from this analysis.

Details of the methodology used in the RCSN, data quality, and definitions are published elsewhere.[18,19] All facilities included in the present study are considered comprehensive or primary stroke centers as per the recommendations from the Brain Attack Coalition.[20] RCSN data were linked with the Canadian Institute for Health Information Discharge Abstract Database (DAD), which contains information on all inpatient hospital activities, including admission and discharge data, length of stay, and types of services utilized. These linkages were performed to determine some of the secondary outcome measures (e.g., length of hospital stay, pneumonia).

Baseline characteristics. Demographic, marital status (single, married/common-in-law, widowed, divorced, unknown), living status (alone, family/friend, unknown), and comorbid conditions were captured from the RCSN. Stroke severity was assessed on admission using the validated Canadian Neurological Scale; higher scores in this scale indicate lower severity.[21,22] Stroke severity was categorized as mild (Canadian Neurological Scale > 8), moderate (Canadian Neurological Scale 5–7), or severe (Canadian Neurological Scale < 4). Patients were classified as being admitted to a stroke unit or to a general ward (e.g., geriatric wards, medical wards). Stroke units were defined as designated wards where care was provided by a multidisciplinary team consisting of physicians, nurses, occupational therapists, speech language pathologists, physiotherapists, dietitians, and social workers. The decision to admit to a stroke unit depended on bed availability at each center. Ischemic stroke subtype was classified as small vessel disease, cardioembolic, large artery atherosclerotic disease, or undetermined according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria based on documentation by the treating physician and the investigations recorded in the chart.[18,23] Patients who were able to complete all activities of daily living in the 3 months prior to the stroke event were classified as independent. Place of residence prior to admission was classified as home, rehabilitation facility, nursing home, retirement home, or undetermined (n = 27; 0.3%).

Exposure. Preexisting dementia was defined as any type of dementia (degenerative, vascular, mixed) that had been identified prior to the index stroke. It includes a chronic loss of mental function or slowly progressive mental decline (for at least 1 month) identified from clinical records, history/physical examination, or on the physician's admission notes.

Outcome measures. ***Clinical outcomes.*** Disability at discharge, stroke-associated pneumonia, and disposition (discharge to a long-term care facility) were the selected clinical outcomes. Disability at discharge was assessed using the modified Rankin Scale (mRS). Stroke-associated pneumonia was defined as radiologically confirmed and developed in the first 30 days poststroke.

Performance indicators of quality of stroke care. As secondary endpoints, we selected key performance indicators as proposed by the Canadian Stroke Quality of Care Study Expert Panel and the American Heart Association/American College of Cardiologists Quality of Care and Outcomes Research in CVD and Stroke Working Groups.[24,25] Main indicators included 1) use of thrombolysis; 2) dysphagia screening; 3) admission to a stroke unit; 4) carotid imaging during hospital stay; 5) antithrombotic therapy at discharge; and 6) warfarin for atrial fibrillation. Other indicators included arrival by ambulance, assessment by physiotherapy, management by stroke team, per-

Table 1 Baseline characteristics of patients with and without dementia

	Overall[a] (n = 9,304), n (%)	Dementia[a] (n = 702), n (%)	No dementia[a] (n = 8,602), n (%)	*p* Value	Standardized difference
Demographics					
Age, y, mean ± SE	71.1 ± 0.15	81.4 ± 0.30	70.3 ± 0.15	<0.001	0.8
Age groups, y				<0.001	
≤59	1,869 (20.1)	11 (1.6)	1,858 (21.6)		0.5
60–69	1,726 (18.6)	49 (7.0)	1,677 (19.5)		0.32
70–79	2,751 (29.6)	191 (27.2)	2,560 (29.8)		0.06
≥80	2,958 (31.8)	451 (64.2)	2,507 (29.1)		0.77
Gender					
Female	4,348 (46.7)	405 (57.7)	3,943 (45.8)	<0.001	0.24
Marital status				<0.001	
Single	841 (9.0)	56 (8.0)	785 (9.1)		0.04
Married/common-law	5,260 (56.5)	300 (42.7)	4,960 (57.7)		0.3
Widowed	2,112 (22.7)	272 (38.7)	1,840 (21.4)		0.42
Divorced or separated	592 (6.4)	22 (3.1)	570 (6.6)		0.14
Unknown	499 (5.4)	52 (7.4)	447 (5.2)		0.1
Living status				<0.001	
Alone	1,971 (21.2)	99 (14.1)	1,872 (21.8)		0.19
Family/friends/other	6,714 (72.2)	567 (80.8)	6,147 (71.5)		0.21
Unknown	618 (6.6)	36 (5.1)	582 (6.8)		0.07
Charlson index				<0.001	
0–1	6,180 (66.4)	192 (27.4)	5,988 (69.6)		0.92
2	1,411 (15.2)	202 (28.8)	1,209 (14.1)		0.41
≥3	1,713 (18.4)	308 (43.9)	1,405 (16.3)		0.72
Clinical presentation					
CNS score,[b] mean ± SE	8.17 ± 0.03	7.03 ± 0.11	8.27 ± 0.03	<0.001	0.45
CNS score group[b]				<0.001	
0	106 (1.2)	10 (1.5)	96 (1.1)		0.03
≤4	929 (10.1)	132 (19.2)	797 (9.4)		0.32
5–7	2,686 (29.3)	273 (39.8)	2,413 (28.5)		0.24
≥8	5,435 (59.4)	271 (39.5)	5,164 (61.0)		0.44
LOC on arrival					
Alert, n/N (%)	8,391 (90.3)	573 (81.9)	7,818 (91.0)	<0.001	0.31
Dysphagia	851 (9.1)	85 (12.1)	766 (8.9)	0.0046	0.11
Comorbid conditions					
Hypertension	6,289 (67.6)	491 (69.9)	5,798 (67.4)	0.17	0.05
Diabetes	2,372 (25.5)	204 (29.1)	2,168 (25.2)	0.024	0.09
Hyperlipidemia	3,252 (35.0)	182 (25.9)	3,070 (35.7)	<0.001	0.21
Atrial fibrillation	1,480 (15.9)	160 (22.8)	1,320 (15.3)	<0.001	0.2
Stroke or TIA	2,972 (31.9)	348 (49.6)	2,624 (30.5)	<0.001	0.41
Bloodwork on admission					
Glucose (mmol/L), mean ± SE	7.67 ± 0.04	7.67 ± 0.13	7.67 ± 0.04	0.99	0
Leukocytes, mean ± SE	9.67 ± 0.25	9.16 ± 0.22	9.71 ± 0.27	0.57	0.02
INR, mean ± SE	1.12 ± 0.01	1.15 ± 0.02	1.12 ± 0.01	0.23	0.05
Premorbid functional status					
Independent	7,644 (82.2)	228 (32.5)	7,416 (86.2)	<0.001	1.51

—*Continued*

Table 1 Continued

	Overall[a] (n = 9,304), n (%)	Dementia[a] (n = 702), n (%)	No dementia[a] (n = 8,602), n (%)	*p* Value	Standardized difference
Arrived from				<0.001	
Complex continuing care	1 (0)	0 (0)	1(0)		0.01
Home	7,254 (77.9)	422 (60.1)	6,832 (79.4)		0.47
Inpatient rehabilitation	29 (0.3)	1 (0.1)	28 (0.3)		0.03
Nursing home	368 (4.0)	183 (26.1)	185 (2.2)		1.3
Transfer from other hospital	721 (7.8)	30 (4.2)	691 (8.0)		0.14
Transfer from ED	769 (8.3)	19 (2.7)	750 (8.7)		0.22
Retirement home	135 (1.5)	45 (6.4)	90 (1.0)		0.45
Undetermined	27 (0.3)	2 (0.3)	25 (0.3)		0
Stroke subtype classification				<0.001	
Large artery disease	1,553 (16.7)	88 (12.5)	1,465 (17.0)		0.12
Cardioembolic	2,138 (23.0)	171 (24.4)	1,967 (22.9)		0.04
Small vessel disease	1,559 (16.8)	127 (18.1)	1,432 (16.6)		0.04
Other cause	961 (10.3)	45 (6.4)	916 (10.6)		0.14
Undetermined/unknown	3,093 (33.2)	271 (38.6)	2,822 (32.8)		0.12
Cardiac investigations					
ECG	1,446 (15.5)	145 (20.7)	1,301 (15.1)	0.0001	0.15
Holter	2,558 (27.5)	141 (20.1)	2,417 (28.1)	<0.001	0.18
Echocardiogram	6,784 (72.9)	450 (64.1)	6,334 (73.6)	<0.001	0.21
Preadmission medications					
Antithrombotics (any)	4,550 (48.9)	415 (59.1)	4,135 (48.1)	<0.001	0.22
Antihypertensive agents	5,845 (62.8)	486 (69.2)	5,359 (62.3)	<0.001	0.14
Statins	2,909 (31.3)	214 (30.5)	2,695 (31.3)	0.64	0.02
Warfarin	879 (9.4)	83 (11.8)	796 (9.3)	0.025	0.09

Abbreviations: ED = emergency department; INR = international normalized ratio; LOC = level of consciousness.
[a] Values in parentheses are column percentages, unless indicated otherwise.
[b] Canadian Neurological Scale (CNS) score was based on 9,156 patients as stroke severity was not available for 148 (1.6%) patients.

manent feeding tube, statins at discharge, and reasons for not giving thrombolysis.

Analysis. χ^2 tests were used to compare categorical variables; analysis of variance or Kruskal-Wallis tests were used to compare mean and median differences for continuous variables in baseline characteristics. As differences may be significant but not clinically meaningful, we used standardized differences (i.e., effect size) to compare baseline characteristics between those with and without dementia. Standardized differences reflect the mean difference as a percentage of the SD. Effect sizes greater than 0.1 are typically felt to be clinically meaningful.[26] Logistic regression analysis was used to analyze the relationship between dementia status and the outcomes of interest. For differences in length of stay, linear regression analysis was conducted. Models were adjusted for well-accepted and clinically relevant confounders including age, sex, stroke severity, and Charlson comorbidity index. Statistical analysis was performed using SAS statistical software version 9.1.3 (Cary, NC: SAS Institute Inc.). All tests were 2-tailed, and p values < 0.05 were considered significant.

Data quality. Chart validation studies have shown good to excellent agreement with the RCSN database, with κ scores of >0.8 for key variables (age, sex, stroke type, thrombolysis use, comorbid conditions) (RCSN report; www.rcsn.org).[18] Unpublished data revealed a high accuracy rate between the DAD which contains data on all hospitalizations across Canada and RCSN for stroke admissions.

Standard protocol approvals, registrations, and patient consents. Ethics approval was obtained from the St. Michael's Hospital institutional review board. The RCSN has the designation of a "prescribed registry," thereby allowing the collection of patient level information without consent for the purpose of facilitating the provision of stroke care in Ontario. The submission of the manuscript was approved by the RCSN Publications Committee.

RESULTS Among 9,304 eligible patients with an acute ischemic stroke, 702 (9.1%) had a history of preexisting dementia. Patients with preexisting dementia were older (81.4 vs 70.3 years; $p < 0.001$) and had more severe strokes (mean Canadian Neurological Scale score 7.03 vs 8.3; $p < 0.001$). Diabetes, atrial fibrillation, and prior stroke/TIA were more prevalent in patients with dementia, whereas hyperlipidemia was more commonly found in patients without dementia. Table 1 summarizes differences in baseline characteristics between groups.

Table 2 Secondary outcome measures: Length of stay, disability, and disposition

Outcome measure	Stroke patients[a] (n = 9,304)		p Value	Standardized difference	Unadjusted OR (95% CI)	Adjusted OR (95% CI)[b]
	Dementia	No dementia				
Total no. of patients	702 (7.5)	8,602 (92.5)	—	—	—	—
Length of hospital stay, d				—		
Mean ± SD	20.8 ± 26.5	14.5 ± 20.7	<0.001	0.29		20.6 (20.2–21.1)[c]
Median (IQR [25%–75%])	13 (6–26)	8 (5–16)	<0.001			13.9 (13.8–14.0)[c]
Disability at discharge (modified Rankin Scale ≥3)	566 (80.6)	4,865 (56.6)	<0.001	0.49	3.20 (2.04–3.87)	1.86 (1.50–2.31)
Pneumonia	62 (8.8)	409 (4.8)	<0.001	0.19	1.94 (1.47–2.57)	0.95 (0.70–1.29)
Discharge disposition (among patients alive at discharge)			<0.001		0.39 (0.32–0.46)	0.65 (0.53–0.79)
Home/place of residence	169 (24.1)	3,873 (45.0)		0.43		
Long-term care facility	274 (39.0)	525 (6.1)		1.24		
Retirement home	27 (3.8)	54 (0.6)		0.35		
Rehabilitation institution	127 (18.1)	3,029 (35.2)		0.36		
Transfer to acute care facility	31 (4.4)	597 (6.9)		0.10		
Other	17 (2.4)	163 (1.9)		0.04		
Missing/unknown	57 (8.1)	361 (4.2)		0.19		
In-hospital mortality	56 (8.0)	352 (4.1)	<0.001	0.19	1.47 (1.11–1.96)	0.91 (0.67–1.24)

Abbreviations: CI = confidence interval; IQR = interquartile range; OR = odds ratio.
[a] Values in parentheses are column percentages, unless indicated otherwise.
[b] Adjusted by age, gender, Charlson Index, and stroke severity (CNS score).
[c] Length of stay adjusted by age, gender, Charlson Index, and stroke severity (Canadian Neurological Scale score) using linear regression.

Clinical outcomes. Clinical outcome measures are summarized in table 2 and figure 1. Mean length of hospital stay (±SD) was greater for patients with dementia (20.8 ± 26.5 days) compared to patients with no dementia (14.5 ± 20.7 days) ($p < 0.001$; standardized difference 0.29).

Stroke patients with dementia were more likely to develop pneumonia (8.8% vs 4.8%; $p < 0.001$). However, the difference disappeared after controlling for confounders (odds ratio [OR] 0.95; 95% confidence interval [CI] 0.70–1.29).

Disability at discharge, using the mRS, was higher in patients with dementia as compared to patients with no dementia (80.6% vs 56.6%; $p < 0.001$ for mRS ≥3) (figure 1). Patients with dementia were less likely to be discharged home or to the same place of residence compared to those without dementia (adjusted OR 0.65; 95% CI 0.53–0.79) (table 2). The additional adjustment by marital status and living arrangements did not alter the results (for disability at discharge: adjusted OR 1.79, 95% CI 1.44–2.22; for discharge disposition: adjusted OR 0.66; 95% CI 0.54–0.80). In addition, patients with preexisting dementia coming from home were less likely to be discharged home compared to patients without dementia (36.5% vs 47.3%, $p < 0.001$) (figure e-1 on the *Neurology*® Web site at www.neurology.org).

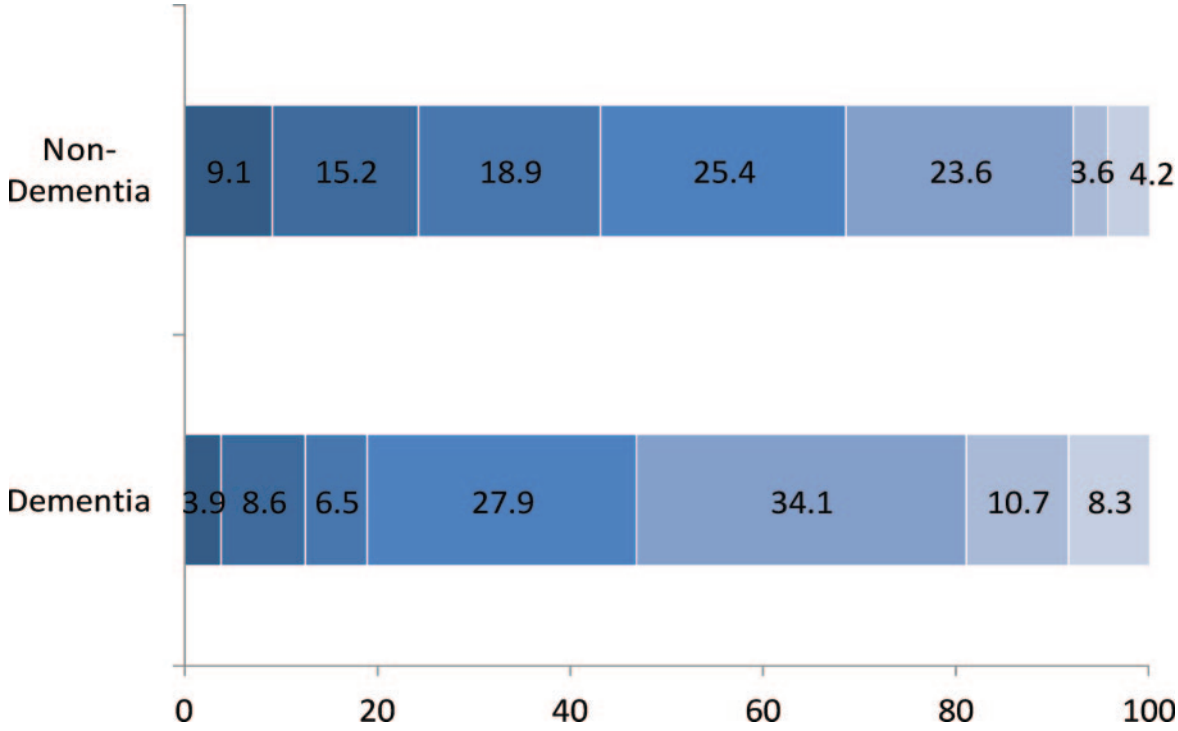
A sensitivity analysis by including patients on palliative care (n = 264 in the dementia group, n = 1,090 in the no dementia group) also showed higher disability, pneumonia, and death at discharge among patients with preexisting dementia (table e-1).

Preadmission dependency (according to activities of daily living 3 months prior to the stroke event). Among patients with preexisting dementia, 228 (32.5%) were independent on admission, compared to 7,416 (86.2%) ($p < 0.001$). Among independent patients with dementia, 54 (24.6%) were institutionalized or dead at discharge compared to 612 (8.25%) patients without dementia (OR 3.62; 95% CI 2.65–4.95).

In contrast, 274/474 (57.8%) patients with dementia who were dependent on admission were discharged to a long-term care institution or died at discharge compared to 332/1,186 (28.0%) of dependent patients without dementia (OR 3.52; 95% CI 2.82–4.40).

Performance measures. Performance measures are detailed in table 3. Patients with preexisting dementia were more likely to arrive to the hospital by ambulance (86.0% vs 69.4%; $p < 0.001$). There were minor differences in admission to stroke unit between patients with and without dementia (63% vs 67.6%; $p = 0.012$, standardized difference 0.1). Patients with preexisting dementia were also less likely to receive carotid imaging during the hospitalization (65.2 vs 80.9; $p < 0.001$, standardized difference

Figure 1 Disability at discharge (modified Rankin Scale [mRS]) in stroke patients with and without preexisting dementia



This figure illustrates the disability at discharge according to the mRS (mRS 0 = no symptoms; 6 = death). $p < 0.001$ when comparing mRS at discharge between patients with and without dementia. 0 = No symptoms (dark blue); 1 = no significant disability (able to carry out all usual activities, despite some symptoms); 2 = slight disability (able to look after own affairs without assistance, but unable to carry out all previous activities); 3 = moderate disability (requires some help, but able to walk unassisted); 4 = moderately severe disability (unable to attend to own bodily needs without assistance, and unable to walk unassisted); 5 = severe disability (requires constant nursing care and attention, bedridden, incontinent); 6 = dead (light blue).

0.39) or to be discharged on statins (64.3% vs 71.1%; $p < 0.001$) than their counterparts.

As there were no meaningful differences (standardized differences <0.1) in most performance measures, no adjustment was made.

Thrombolytic therapy. Thrombolytic therapy is detailed in table 3. Overall, there were 1,268 (13.6%) patients who received IV thrombolysis. Patients with preexisting dementia were less likely to receive IV thrombolysis (10.5% vs 15.67%; $p < 0.001$) than their counterparts without dementia (table 3), and this was true even after adjustment for age, sex, stroke severity, and Charlson index (OR 0.54; 95% CI 0.41–0.70).

Similar results were observed for patients who had no contraindication for thrombolysis. Treatment was given to 72/288 (25%) patients with preexisting dementia who arrived within 3 hours of stroke onset compared to 1,305/3,510 (37.2%) of those without dementia ($p < 0.0001$). For those with no contraindications, IV thrombolysis was administered to 72/270 (26.7%) patients with dementia vs 1,305/1,358 (40.1%) without dementia ($p < 0.0001$).

Reasons for not receiving IV thrombolysis in patients with and without preexisting dementia are presented in table 4. Medical contraindications were the most common reason for not administering thrombolysis. Other medical reasons not considered contraindications were more common in patients with preexisting dementia (13.5% vs 7.5%; $p < 0.001$). No significant differences were observed between patients with and without dementia in the administration of thrombolysis by place of arrival (home, nursing home/long-term care, retirement home).

DISCUSSION The care of patients with dementia raises several diagnostic, management, and ethical issues. The relationship between stroke and dementia is complex: cerebral infarction itself is a risk factor for poststroke dementia[27,28] and prestroke cognitive impairment or dementia is a risk factor for stroke.[29,30] Concomitant cortical or subcortical stroke with Alzheimer pathology accelerates clinical expression of dementia, which is pertinent to both the acute and chronic phase of stroke recovery.[31] As the prevalence of both stroke and dementia increase with age, and with aging of the general population, physicians will encounter more patients presenting with an acute ischemic stroke and preexisting dementia.[32,33]

How to best manage stroke patients with preexisting dementia is under debate. As mentioned, some

Table 3 Performance measures[a]

Domains and indicators	Overall (n = 9,304)	Dementia (n = 702)	No dementia (n = 8, 602)	*p* Value	Standardized difference[b]
Acute treatment of ischemic stroke					
Arrival by ambulance	6,578 (70.7)	604 (86.0)	5,974 (69.4)	<0.001	0.37
Thrombolytic therapy	1,426 (15.3)	74 (10.5)	1,352 (15.7)	<0.001	0.14
Thrombolytic therapy for eligible patients (those arriving within 150 min, no contraindications, moderate to severe deficit)	1,349 (50.8)	69 (34.3)	1,280 (52.1)	<0.001	0.36
Swallowing assessment	6,328 (68.1)	501 (71.4)	5,827 (67.8)	0.051	0.080
Organization of stroke evaluation and access to specialized care					
Admission to designated stroke units	6,256 (67.2)	442 (63.0)	5,814 (67.6)	0.012	0.10
Management by stroke team	6,442 (69.2)	452 (64.4)	5,990 (69.6)	0.004	0.11
Physiotherapy	8,127 (87.3)	637 (90.7)	7,490 (87.1)	0.005	0.11
Carotid imaging before discharge	7,415 (79.7)	458 (65.2)	6,957 (80.9)	<0.001	0.39
Any permanent feeding tube	412 (4.4)	52 (7.4)	360 (4.2)	<0.001	0.16
Secondary stroke prevention[c] (among patients discharged alive)					
Antithrombotics at discharge	8,612 (96.9)	627 (97.4)	7,985 (96.9)	0.53	0.03
Antihypertensive therapy at discharge (any)	7,170 (80.7)	543 (84.3)	6,627 (80.4)	0.016	0.10
ACE inhibitor	4,667 (52.5)	337 (52.3)	4,330 (52.6)	0.91	<0.001
ARB	1,048 (11.8)	59 (9.2)	989 (12.0)	0.031	0.090
β-Blocker	3,425 (38.6)	270 (41.9)	3,155 (38.3)	0.07	0.070
CCB	2,531 (28.5)	194 (30.1)	2,337 (28.4)	0.34	0.040
Diuretic	2,991 (33.7)	258 (40.1)	2,733 (33.2)	<0.001	0.15
Statins at discharge	6,269 (70.6)	414 (64.3)	5,855 (71.1)	<0.001	0.15
Patients with atrial fibrillation discharged on warfarin[d]	1,384 (71.8)	120 (56.9)	1,264 (73.7)	<0.001	0.36

Abbreviations: ACE = angiotensin-converting enzyme; ARB = angiotensin II receptor blocker; CCB = calcium-channel blocker.
[a] Numbers in parentheses represent percentages unless otherwise specified.
[b] Standardized differences ≤0.1 are not considered meaningful.
[c] Information was not available for 421 (4.5%) patients.
[d] Represents the % of patients with atrial fibrillation discharged on anticoagulation therapy (warfarin/Coumadin, heparin) in the absence of contraindications (active liver disease, active bleeding, or terminal illness, patients receiving palliative care).

facilities may limit access to specialized care for patients with dementia (e.g., access to coronary care units for patients with myocardial infarction, brain imaging for patients with acute stroke, antibiotic treatment for pneumonia or tube feeding).[10,15–17] The lack of established guidelines for the management and treatment of stroke patients with dementia contributes to this uncertainty. Unfortunately, up to now, there has been limited information on access to care, processes of care, and outcomes in patients with preexisting dementia presenting with an acute ischemic stroke. Moreover, limited information is available regarding thrombolysis use and outcomes in this subgroup of patients.

In this study, we describe the demographics and clinical differences between patients with and without dementia who experienced an acute ischemic stroke. We also evaluate well-accepted process measures and functional outcomes (e.g., disability at discharge and disposition) in these patients. Our study provides "real world" information on access to care, process measures, and discharge disposition for stroke patients with and without preexisting dementia. Differences in clinical outcomes were greater if patients on palliative care were included in the study (sensitivity analysis). Patients with a history of dementia tended to be older women, and had a higher prevalence of comorbidities (e.g., atrial fibrillation and diabetes) and more severe strokes. As expected, patients with dementia were less likely than those without dementia to receive IV thrombolysis, even in the absence of recognized contraindications. Differences in age, stroke severity, and overall frailty may explain why clinicians decided not to treat these patients with thrombolysis. Medical complications, intracerebral hemorrhage, and survival were similar among patients receiving thrombolysis with (n = 74) or without dementia (n = 1,352). However, we cannot rule out a type II error due to the relatively small sample size.

Among patients living at home prior to stroke, those with dementia had a very high rate of discharge to nursing homes or long-term care facilities after stroke. Moreover, most patients coming from a nurs-

Table 4 Reasons thrombolysis was not administered[a]

Reason thrombolysis was not given	Dementia (n = 628)	No dementia (n = 7, 250)	Standardized difference	p Value
Arrival more than 3 hours after stroke onset (%)[b]	27.1	29.4	0.05	0.29
Patient condition too mild (e.g., deficit resolved, rapidly improving, or low NIHSS)	13.2	16.8	0.10	0.054
Patient condition too severe (e.g., decreased level of consciousness or high NIHSS)	4.3	1.4	0.23	<0.001
Delay in decision to treat	1	0.6	0.04	0.51
Other contraindications to thrombolysis	7.0	6.0	0.04	0.31
Physician decision	13.5	7.5	0.22	<0.001
No reason stated	39.8	41.3	0.03	0.48

Abbreviation: NIHSS = NIH Stroke Scale.
[a] Numbers in columns represent percentages unless otherwise specified. In some patients more than one reason was stated, explaining the total percentages over 100.
[b] Accepted time window according to the current national guidelines during the study and before the publication of the ECASS 3.[34]

ing home or long-term care were discharged back to those institutions. Together, these findings highlight the frailty of stroke patients with preexisting dementia and their poor clinical recovery. Differences in demography, comorbidity, and disability make these patients highly vulnerable.

In a retrospective analysis using Medicare database including patients presenting an acute myocardial infarction (n = 129,092), a history of dementia was associated with lower use of ACE inhibitors at discharge (RR = 0.90, 95% CI = 0.86–0.95), thrombolytic therapy (RR = 0.82, 95% CI = 0.74–0.90), catheterization (RR = 0.51, 95% CI = 0.47–0.55), coronary angioplasty (RR = 0.58, 95% CI = 0.51–0.66), and cardiac bypass surgery (RR = 0.41, 95% CI = 0.33–0.50).[12] We found similar results for thrombolysis use and carotid imaging before discharge in our cohort of stroke patients.

Our study has limitations and strengths that deserve comment. First, we have no information about the accuracy of the diagnosis of dementia. It is possible that patients with mild cognitive impairment or mild dementia were not captured. We would argue this reflects a common scenario in real life (individuals with mild cognitive impairment/dementia are not usually diagnosed until more advanced stages). Second, although we controlled for common confounding factors, the possibility of unmeasured and residual confounding remains. We also have limited information on neuroimaging, dementia subtype, and severity. Therefore, it is possible that some imaging findings (e.g., cerebral atrophy) may affect clinical decisions, and therefore also explain the lower thrombolytic rate among stroke patients with preexisting dementia. Finally, we have limited information about the rationale for physicians' decisions or preferences related to stroke management beyond thrombolysis.

Despite these limitations, our study constitutes a first step in understanding the demographic and clinical factors associated with processes of care, clinical outcomes, and disposition for patients with an acute ischemic stroke and preexisting dementia. In this group, decisions made early during the hospitalization (e.g., stroke unit admission, thrombolysis) will likely have relevant impact on their outcomes, disposition, and rehabilitation strategy. This information may also help clinicians facilitating patient or family counseling or discussions pertaining to end-of-life decisions. What this study shows is that 4 out of 5 stroke patients with preexisting dementia were disabled at discharge with greater need for institutionalization, posing a greater health care burden.

Further studies are needed to determine which prognostic factors may help clinical decision-making in individual cases (e.g., weighing need for anticoagulation in stroke patients with dementia and atrial fibrillation who may show microbleeds on gradient echo MRI against the risks of cerebral hemorrhage and thrombolysis in institutionalized patients with preexisting dementia). Given the present demographic trends toward aging of the population, governments, policy-makers, health care providers, and health insurance representatives will need to work together to discuss achievable goals and priorities to reduce the impact of stroke in this population.

AUTHOR CONTRIBUTIONS

Dr. Saposnik: drafting/revising the manuscript, study concept or design, analysis or interpretation of data, contribution of vital reagents/tools/patients, acquisition of data, study supervision. Dr. Cote: drafting/revising the manuscript, analysis or interpretation of data. Dr. Rochon: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. Mamdani: drafting/revising the manuscript, study concept or design, analysis or interpretation of data, statistical analysis. Y. Liu: analysis or interpretation of data, acquisition of data, statistical analysis. S. Raptis: drafting/revising the manuscript, study supervision. Dr. Kapral: drafting/revising the manuscript, study concept or design, analysis or interpretation of data, acquisition of data. Dr. Black: drafting/revising the manuscript, study concept or design, analysis or interpretation of data.

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DISCLOSURE

Dr. Saposnik serves on the editorial board of *Stroke*; served on a scientific advisory board for sanofi-aventis; and receives salary support from the Clinician-Scientist Award from the Heart and Stroke Foundation of Ontario. Dr. Cote serves on a scientific advisory board for Bayer Schering Pharma and a DSMB for the NIH; has received speaker honoraria from Boehringer Ingelheim, sanofi-aventis, and Merck Serono; and serves as a consultant for Otsuka Pharmaceutical Co., Ltd. Dr. Rochon serves on editorial advisory boards for the *Open Medicine Journal*, *Drugs & Aging*, the *American Journal of Geriatric Pharmacotherapy*, *Aging Health*, and the *International Journal of Psychiatry in Medicine*. Dr. Mamdani serves on scientific advisory boards for Pfizer Inc, Eli Lilly and Company, Roche, and Boehringer Ingelheim. Y. Liu and S. Raptis report no disclosures. Dr. Kapral serves on the editorial board of *Stroke*; holds a career investigator award from the Canadian Institutes for Health Research; and receives research support from the Canadian Stroke Network and the University Health Network Women's Health Program. Dr. Black has served on scientific advisory boards for Pfizer Inc and Roche; serves on the editorial boards of *Alzheimer's Research & Therapy*, *Brain and Behavior*, and the *Chinese Journal of Geriatrics*; holds a patent re: INCAS (Integrated Neuro-Cognitive Assessment System)-Cognitive Assessment Tool and Method; and receives research support from Roche, GlaxoSmithKline, Pfizer Inc, Novartis, the CIHR, the NIH, the Canada Foundation for Innovation, the Canadian Stroke Network, and the Heart and Stroke Foundation of Ontario.

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Care and outcomes in patients with ischemic stroke with and without preexisting dementia

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