Pre-stroke dementia and in-hospital outcomes in the Chinese Stroke Center Alliance

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Background: Little is known about the impact of prevalent dementia on in-hospital outcomes of patients with incident stroke in China. Using data from the Chinese Stroke Center Alliance (CSCA), we aim to quantify the prevalence of pre-stroke dementia and whether this group is at higher risk of adverse in-hospital outcomes compared to those without pre-stroke dementia.

Methods: We used multivariable logistic regression models to assess the associations between pre-stroke dementia and ambulation by day 2, in-hospital mortality, in-hospital complications, and being discharged home. Covariates included age, sex, comorbidities [dyslipidemia, atrial fibrillation, peripheral vascular disease (PVD), smoking, and alcohol use], medication history (antiplatelet drugs or lipid-lowering drugs), stroke severity [measured by the National Institute of Health Stroke Scale (NIHSS)], administration of intravenous tissue plasminogen activator (IV tPA) within 4.5 hours of stroke onset, and receipt of deep vein thrombosis (DVT) prophylaxis if indicated.

Results: In the final analytic sample of 559,070 ischemic stroke patients with no prior stroke history enrolled across 1,476 hospitals, those with pre-stroke dementia (n=1,511; 0.3%) were older and more likely to be female. Despite having received similar treatment, patients with pre-stroke dementia had lower odds of ambulating by day 2 [odds ratio (OR) =0.69; 95% confidence interval (CI): 0.62–0.78], higher odds of in-hospital mortality (OR =2.01; 95% CI: 1.35–2.99) or complications (OR =2.17; 95% CI: 1.93–2.44), and lower odds of being discharged home compared to those without pre-stroke dementia (OR =0.71; 95% CI: 0.62–0.83).

Conclusions: Worse in-hospital outcomes among patients with pre-stroke dementia may be explained by pre-existing cognitive impairment that limited their ability to advocate for care needs. Further research is needed to determine whether a different care pathway or additional attention from clinicians is necessary for patients with pre-stroke dementia.

Keywords: China; inpatients; dementia; registries; stroke

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Introduction

Stroke is the second leading cause of death and the third leading cause of disability globally (1). In China, stroke is the leading contributor to disability-adjusted life-years with 3.94 million new cases in 2019 (2,3). Dementia also presents a significant burden to the healthcare system; China has more dementia cases than any other country in the world, affecting approximately 6% of people aged 60 years and older (4), although estimates of prevalence and incidence remain inconsistent across epidemiological studies (5). A combination of stroke and dementia could lead to adverse outcomes that disproportionately affect the aging population.

Pre-stroke cognitive impairment or dementia is infrequently assessed, despite evidence that it may predict further decline after a stroke (6,7). Patients admitted with an acute ischemic stroke (AIS) and a history of cognitive impairment or dementia have higher stroke severity, more in-hospital complications, worse functional outcomes at discharge and higher odds of in-hospital death (8-10). Studies from other countries have estimated the prevalence of pre-stroke dementia to be around 10–17% (8-10), with mixed findings on the association between pre-stroke dementia and in-hospital outcomes. A study using the Fukuoka Stroke Registry in Japan found that pre-stroke dementia was associated with poor functional outcomes (11), while a study from Israel found no association (12). On balance, there is a need for empirical evidence to inform clinical decision-making and policy for how pre-stroke dementia is handled upon admission for a stroke in China.

The Chinese Stroke Center Alliance (CSCA) was developed by the Chinese Stroke Association with the goal of improving healthcare quality for patients admitted with an acute stroke. In this study, we aim to use data from the CSCA to describe the prevalence of pre-stroke dementia in China and to compare the demographics, clinical characteristics, adherence to performance indicators during hospitalization, and in-hospital outcomes of AIS patients with or without pre-stroke dementia. We further aim to understand whether pre-stroke dementia is independently associated with in-hospital outcomes (ambulation, complications, mortality) or discharge location. We present the following article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-723/rc).

Methods

CSCA

The CSCA is a national hospital-based quality improvement initiative made available to all secondary and tertiary hospitals in China. Hospitals were surveyed on characteristics including geographic region, teaching versus non-teaching status, hospital volume, and annual stroke patient volume. Participating hospitals enrolled patients who were over 18 years of age, had a primary diagnosis of acute stroke/transient ischemic attack (TIA) confirmed by brain CT or MRI, were within seven days of symptom onset at the time of enrollment, and were admitted directly to a stroke unit or through the emergency department. Participating hospitals received either research approval to collect data without requiring individual informed consent under the common rule or a waiver of authorization and exemption from the hospital's Institutional Review Board. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the ethics board of Beijing Tiantan Hospital (approval number: KY2018-061-02).

Patients were enrolled from 1,476 hospitals across all 31 provinces, autonomous regions or municipalities in Mainland China participating in the CSCA from August 1, 2015, to July 31, 2019. A total of 38.8% of the hospitals enrolled were secondary hospitals and 28.6% were located in the eastern region of Mainland China.

Data were collected using a web-based patient data collection and management tool (Medicine Innovation Research Center, Beijing, China), abstracted through chart review, and de-identified to protect patient privacy. Patient data included demographics, medication history, comorbidities, hospital presentation, initial neurological status, medications and interventions received during hospitalization, reperfusion strategy, in-hospital outcomes, and in-hospital complications. All data were audited regularly to identify potentially invalid formats or out-of-range values. All data were submitted to the China National Clinical Research Center for Neurological

Diseases (NCRCND) for analysis. Additional details on the recruitment and data collection procedures for the CSCA have been described elsewhere (13).

Inclusion criteria and variables

We included patients who were admitted with an ischemic stroke and did not have a history of stroke prior to the index event. Descriptive analyses were conducted to present a profile of patients' demographic and clinical characteristics, in-hospital outcomes (including complications), and in-hospital treatment procedures according to national guidelines. Descriptive statistics were presented for those with versus without pre-stroke dementia.

Demographic variables collected by self-report included age, sex, income, and education level. Patients were surveyed on whether they had a history of hypertension, diabetes mellitus, dyslipidemia, coronary heart disease (CHD) or myocardial infarction (MI), atrial fibrillation, peripheral vascular disease (PVD), dementia, smoking, or alcohol use. Patients were also surveyed on whether they had ever been prescribed antiplatelets, anticoagulants, antihypertensives, antidiabetics, or statins. The National Institute of Health Stroke Scale (NIHSS) score at admission was recorded as a measure of stroke severity.

In-hospital complications, outcomes, and adherence to performance measures were documented by healthcare personnel over the course of the hospital stay. In-hospital outcomes included ambulating by day 2, having had any complications, experiencing in-hospital mortality, and being discharged home. In-hospital complications included pulmonary embolism, pneumonia, deep vein thrombosis (DVT), urinary tract infection (UTI), decubitus, gastrointestinal (GI) bleeding, and depression.

Data on whether AIS patients received adequate treatment were summarized in 13 performance metrics. Acute performance measures included whether patients received (I) intravenous recombinant tissue plasminogen activator within 4.5 hours of stroke onset, (II) endovascular treatment within 6 hours of stroke onset, (III) early antithrombotics, (IV) DVT prophylaxis, (V) dysphagia screening, and (VI) rehabilitation assessment. Discharge performance measures included whether patients received (I) antithrombotic medication, (II) anticoagulation for atrial fibrillation, (III) antihypertensive medicines for patients with hypertension, (IV) statin therapy for low-density lipoprotein ≥100 mg/dL, (V) hypoglycemia medication for diabetes mellitus, (VI) health education on smoking cessation, and (VII) weight loss-related health education.

Statistical analyses

Continuous variables were presented as means and standard deviations, and group comparisons were conducted using *t*-tests or Wilcoxon rank-sum tests. Categorical variables were presented as counts and percentages, and group comparisons were conducted using chi-square tests of significance.

Multivariable logistic regressions were conducted to assess the association between pre-stroke dementia status and the main outcomes of interest—ambulation by day 2, in-hospital mortality, in-hospital complications, and being discharged home. Separate analyses were conducted for individual complications. Multivariable logistic regressions were adjusted for age, sex, comorbidities (dyslipidemia, atrial fibrillation, PVD, smoking, alcohol use), medication history (use of antiplatelet drugs or lipid-lowering drugs), NIHSS score, IV tPA <4.5 hours, and DVT prophylaxis. Odds ratio (OR) and 95% confidence interval (CI) were presented for both the adjusted and unadjusted models.

P values and absolute standardized differences (ASD) were calculated for all tests of significance. We expected statistical tests to yield small P values due to the large sample size, and thus used ASDs for the interpretation of between-group differences. An ASD of 10 or higher was considered statistically significant (14). All statistical analyses were performed using SAS Version 9.4 (SAS Institute, Cary, NC, USA).

Results

Patient characteristics and treatment

Out of the 1,006,798 patients enrolled across 1,476 hospitals in the CSCA, we included patients who had an incident ischemic stroke (n=838,229) without a prior history of stroke (n=559,070). In this analytic sample of 559,070 patients, 1,511 (0.3%) had pre-stroke dementia (*Figure 1*).

Compared to patients without pre-stroke dementia, those with pre-stroke dementia were older (mean age 76.9 *vs.* 65.5 years; P<0.0001; ASD =98.9%), less likely to be male (48.4% *vs.* 62.0%; P<0.0001; ASD =27.6%), more likely to have monthly family income exceeding 5,000 Chinese Yuan (7.5% *vs.* 4.4%; P<0.0001; ASD =13.1%), and had lower levels of education (below elementary education level: 41.5% *vs.* 30.5%; P<0.0001; ASD =23.1%).

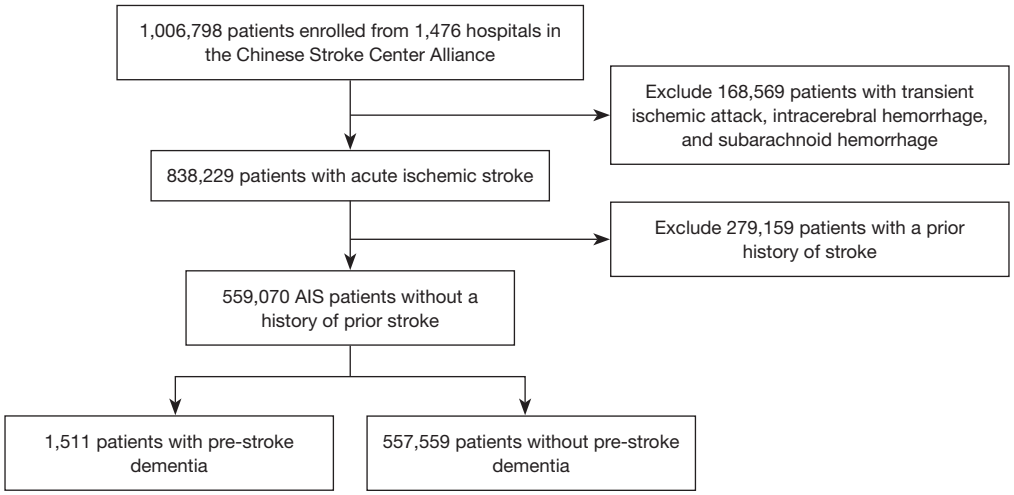

Figure 1 Flowchart of patients' identification. AIS, acute ischemic stroke.

A higher proportion of those with pre-stroke dementia had dyslipidemia (6.6% *vs.* 4.1%; P<0.0001; ASD =11.1%), atrial fibrillation (7.4% *vs.* 4.6%; P<0.0001; ASD =11.8%), or PVD (2.4% *vs.* 0.7%; P<0.0001; ASD =13.8%). A lower proportion of those with pre-stroke dementia had a history of smoking (24.0% *vs.* 36.8%; P<0.0001; ASD =28.1%) or alcohol use (12.6% *vs.* 23.5%; P<0.0001; ASD =28.6%), and had more severe strokes at admission (mean NIHSS of 7.0 *vs.* 4.3; P<0.0001; ASD =49.1%). A higher proportion of those with pre-stroke dementia had a history of using antiplatelet medication (15.8% *vs.* 9.4%; P<0.0001; ASD =19.4%) or lipid-lowering medication (10.7% *vs.* 6.6%; P<0.0001; ASD =14.6%) (*Table 1*).

Adherence to performance indicators

A smaller proportion of patients with pre-stroke dementia received IV tPA within 4.5 hours of stroke onset (19.6% *vs.* 26.8%; P=0.0058; ASD =15.8%) and a higher proportion received DVT prophylaxis (54.7% *vs.* 43.2%; P<0.0001; ASD =23.2%). A smaller proportion received anticoagulation for atrial fibrillation (34.5% *vs.* 49.3%; P=0.0066; ASD =24.9%) or hypoglycemia medication (82.8% *vs.* 87.0%; P=0.0305; ASD =10.4%) at discharge. A smaller proportion received weight loss-related health education at discharge (79.2% *vs.* 88.3%; P<0.0001; ASD =24.7%). Pre-stroke dementia was not significantly associated with the remaining indicators for adherence to evidence-based performance (*Table 2*).

In-hospital outcomes

Pre-stroke dementia was associated with nearly all of the adverse outcomes. Compared to those without pre-stroke dementia, a smaller proportion of patients with pre-stroke dementia ambulated by day 2 (47.2% *vs.* 69.4%; P<0.0001; ASD =46.2%) and a higher proportion had any complications during hospitalization (34.5% *vs.* 11.4%; P<0.0001; ASD =57.1%). Of the 63,950 complications recorded this study sample, 46,698 (73.0%) were cases of pneumonia. A higher proportion of those with pre-stroke dementia had pneumonia, compared to those without pre-stroke dementia (26.9% *vs.* 8.3%; P<0.0001; ASD =50.4%). A higher proportion of those with pre-stroke dementia had a UTI, decubitus, GI bleeding, and depression, but not pulmonary embolism or DVT. Additionally, patients with pre-stroke dementia were more likely to die during hospitalization (1.8% *vs.* 0.4%; P<0.0001; ASD =13.5%) and less likely to be discharged home (84.3% *vs.* 90.7%; P<0.0001; ASD =19.4%) (*Table 3*).

When adjusted for covariates, patients with pre-stroke dementia had lower odds of ambulating by day 2 (OR =0.69; 95% CI: 0.62–0.78) and higher odds of having any complications (OR =2.17; 95% CI: 1.93–2.44), including higher odds of having pneumonia (OR =1.95; 95% CI: 1.72–2.22), a UTI (OR =1.59; 95% CI: 1.18–2.15; P=0.0022), decubitus (OR =5.65; 95% CI: 4.12–7.75; P<0.0001), GI bleeding (OR =1.90; 95% CI: 1.39–2.61; P=0.0005) and depression (OR =2.17; 95% CI: 1.60–2.94; P<0.0001), compared to patients without pre-stroke

Table 1 Baseline characteristics of pre-stroke dementia among patients with AIS (n=559,070)

Variables	Total	Pre-stroke dementia (n=1,511; 0.3%)	No dementia (n=557,559; 99.7%)	P	ASD (%)
Age, years	65.6±12.4	76.9±10.7	65.5±12.3	<0.0001	98.9
Male	346,420 (62.0)	732 (48.4)	345,688 (62.0)	<0.0001	27.6
Monthly family income				<0.0001	
Unavailable	292,535 (52.3)	759 (50.2)	291,776 (52.3)		4.2
≤1,000 CNY	43,397 (7.8)	144 (9.5)	43,253 (7.8)		6.1
1,001–5,000 CNY	198,267 (35.5)	495 (32.8)	197,772 (35.5)		5.7
≥5,001 CNY	24,871 (4.4)	113 (7.5)	24,758 (4.4)		13.1
Education level				<0.0001	
Unknown	206,271 (36.9)	505 (33.4)	205,766 (36.9)		7.3
College	16,779 (3.0)	51 (3.4)	16,728 (3.0)		2.3
High school	165,217 (29.6)	328 (21.7)	164,889 (29.6)		18.2
Below elementary	170,803 (30.6)	627 (41.5)	170,176 (30.5)		23.1
Comorbidities					
Hypertension	332,305 (59.4)	868 (57.4)	331,437 (59.4)	0.1140	4.1
Diabetes mellitus	106,521 (19.1)	328 (21.7)	106,193 (19.0)	0.0085	6.7
Dyslipidemia	23,173 (4.1)	100 (6.6)	23,073 (4.1)	<0.0001	11.1
CHD or previous MI	42,991 (7.7)	151 (10.0)	42,840 (7.7)	0.0008	8.1
Atrial fibrillation	25,794 (4.6)	112 (7.4)	25,682 (4.6)	<0.0001	11.8
PVD	3,754 (0.7)	37 (2.4)	3,717 (0.7)	<0.0001	13.8
Smoking	205,484 (36.8)	363 (24.0)	205,121 (36.8)	<0.0001	28.1
Alcohol use	131,338 (23.5)	190 (12.6)	131,148 (23.5)	<0.0001	28.6
Medication history					
Antiplatelet	52,917 (9.5)	239 (15.8)	52,678 (9.4)	<0.0001	19.4
Anticoagulation	10,493 (1.9)	26 (1.7)	10,467 (1.9)	0.6542	1.5
Antihypertensive	226,834 (40.6)	591 (39.1)	226,243 (40.6)	0.2470	3.1
Antidiabetics	80,302 (14.4)	249 (16.5)	80,053 (14.4)	0.0189	5.8
Lipid-lowering	36,789 (6.6)	162 (10.7)	36,627 (6.6)	<0.0001	14.6
NIHSS score at admission	4.3±4.7	7.0±6.2	4.3±4.7	<0.0001	49.1

Data are present as mean ± SD or n (%). AIS, acute ischemic stroke; ASD, absolute standardized difference; CNY, Chinese Yuan; CHD, coronary heart disease; MI, myocardial infarction; PVD, peripheral vascular disease; NIHSS, National Institute of Health Stroke Scale.

dementia. Multivariable analyses also showed higher odds of in-hospital mortality (OR =2.01; 95% CI: 1.35–2.99; P<0.0001) and lower odds of discharge home (OR =0.71; 95% CI: 0.62–0.83; P<0.0001) for those with pre-stroke dementia compared to those without pre-stroke dementia (*Table 4*).

Discussion

In this retrospective analysis of data from the CSCA, patients with pre-stroke dementia had significantly worse in-hospital outcomes including lower odds of ambulating

Table 2 Adherence to evidence-based performance

Performance indicators	Total	Pre-stroke dementia (n=1,511; 0.3%)	No dementia (n=557,559; 99.7%)	P	ASD (%)
IV tPA <4.5 hours, n/n (%)	32,639/121,825 (26.8)	64/327 (19.6)	32,575/121,498 (26.8)	0.0058	15.8
Early antithrombotics, n/n (%)	477,483/546,100 (87.4)	1,268/1,439 (88.1)	476,215/544,661 (87.4)	0.3869	2.4
DVT prophylaxis, n/n (%)	72,683/168,125 (43.2)	423/773 (54.7)	72,260/167,352 (43.2)	<0.0001	23.2
Dysphagia screening, n/n (%)	439,886/552,658 (79.6)	1,245/1,506 (82.7)	438,641/551,152 (79.6)	0.0004	9.4
Rehabilitation assessment, n/n (%)	414,121/558,893 (74.1)	1,152/1,510 (76.3)	412,969/557,383 (74.1)	0.0542	4.9
Antithrombotics at discharge, n/n (%)	487,675/542,710 (89.9)	1,237/1,394 (88.7)	486,438/541,316 (89.9)	0.2040	3.2
Anticoagulation for AF at discharge, n/n (%)	16,249/32,988 (49.3)	39/113 (34.5)	16,210/32,875 (49.3)	0.0066	24.9
Antihypertensive medicines at discharge, n/n (%)	257,660/325,698 (79.1)	624/814 (76.7)	257,036/324,884 (79.1)	0.6070	1.7
Statin therapy at discharge, n/n (%)	498,739/551,827 (90.4)	1,291/1,455 (88.7)	497,448/550,372 (90.4)	0.0446	5.2
Hypoglycemia medication at discharge, n/n (%)	112,919/129,749 (87.0)	299/361 (82.8)	112,620/129,388 (87.0)	0.0305	10.4
Smoking cessation education at discharge, n/n (%)	135,318/140,568 (96.3)	142/147 (96.6)	135,176/140,421 (96.3)	0.7364	2.7
Weight loss-related health education at discharge, n/n (%)	490,583/555,783 (88.3)	1,173/1,481 (79.2)	489,410/554,302 (88.3)	<0.0001	24.7
Healthy diet education at discharge, n/n (%)	544,788/555,783 (98.0)	1,435/1,481 (96.9)	543,353/554,302 (98.0)	0.0028	6.7
Diabetes health education at discharge, n/n (%)	139,383/144,208 (96.7)	388/407 (95.3)	138,995/143,801 (96.7)	0.1346	7.0

ASD, absolute standardized difference; IV tPA, intravenous tissue plasminogen activator; DVT, deep vein thrombosis; AF, atrial fibrillation.

Table 3 In-hospital outcomes

In-hospital outcomes	Total	Pre-stroke dementia (n=1,511; 0.3%)	No dementia (n=557,559; 99.7%)	P	ASD (%)
Ambulated by day 2, n (%)	387,671 (69.3)	713 (47.2)	386,958 (69.4)	<0.0001	46.2
Complications, n (%)	63,950 (11.4)	522 (34.5)	63,428 (11.4)	<0.0001	57.1
Pulmonary embolism	973 (0.2)	5 (0.3)	968 (0.2)	0.1429	2.0
Pneumonia	46,698 (8.4)	406 (26.9)	46,292 (8.3)	<0.0001	50.4
DVT	4,477 (0.8)	27 (1.8)	4,450 (0.8)	<0.0001	8.8
UTI	5,852 (1.0)	46 (3.0)	5,806 (1.0)	<0.0001	14.3
Decubitus	1,143 (0.2)	44 (2.9)	1,099 (0.2)	<0.0001	22.0
GI bleeding	4,459 (0.8)	42 (2.8)	4,417 (0.8)	<0.0001	15.1
Depression	6,101 (1.1)	44 (2.9)	6,057 (1.1)	<0.0001	12.9
In-hospital mortality, n (%)	2,193 (0.4)	27 (1.8)	2,166 (0.4)	<0.0001	13.5
Discharged home, n (%)	506,970 (90.7)	1,274 (84.3)	505,696 (90.7)	<0.0001	19.4

ASD, absolute standardized difference; DVT, deep vein thrombosis; UTI, urinary tract infection; GI, gastrointestinal.

by day 2 and higher odds of having any complications. The care received by patients with pre-stroke dementia, as measured by performance indicators standardized across hospitals, was largely equivalent to that of patients without dementia. As studies have highlighted the significant contributions of prior strokes to the vascular and

Table 4 Association between pre-stroke dementia status and in-hospital outcomes

In-hospital outcomes	Unadjusted model		Multivariable model[†]	
	OR (95% CI)	P value	OR (95% CI)	P value
Ambulated by day 2	0.39 (0.36–0.44)	<0.0001	0.69 (0.62–0.78)[‡]	<0.0001
Complications	4.11 (3.70–4.57)	<0.0001	2.17 (1.93–2.44)	<0.0001
Pulmonary embolism	1.91 (0.79–4.60)	0.1496	1.46 (0.61–3.54)	0.3981
Pneumonia	4.06 (3.62–4.55)	<0.0001	1.95 (1.72–2.22)	<0.0001
DVT	2.27 (1.55–3.32)	<0.0001	1.34 (0.91–1.97)	0.1423
UTI	2.98 (2.22–4.01)	<0.0001	1.59 (1.18–2.15)	0.0022
Decubitus	15.19 (11.19–20.62)	<0.0001	5.65 (4.12–7.75)	<0.0001
GI bleeding	3.58 (2.63–4.87)	<0.0001	1.90 (1.39–2.61)	<0.0001
Depression	2.73 (2.02–3.69)	<0.0001	2.17 (1.60–2.94)	<0.0001
In-hospital mortality	4.67 (3.19–6.85)	<0.0001	2.01 (1.35–2.99)	0.0005
Discharged home	0.55 (0.48–0.63)	<0.0001	0.71 (0.62–0.83)	<0.0001

[†], adjusted for age, sex, comorbidities (dyslipidemia, atrial fibrillation, PVD, smoking, and alcohol use), medication history (antiplatelet drugs or lipid-lowering drugs), stroke severity (NIHSS score), IV tPA <4.5 hours, and DVT prophylaxis; [‡], adjusted for the same covariates as above except for DVT prophylaxis. OR, odds ratio; CI, confidence interval; DVT, deep vein thrombosis; UTI, urinary tract infection; GI, gastrointestinal; PVD, peripheral vascular disease; NIHSS, National Institute of Health Stroke Scale; IV tPA, intravenous tissue plasminogen activator.

degenerative pathologies that characterize dementia (15), we excluded prevalent stroke cases in order to isolate the association between pre-stroke dementia and in-hospital outcomes independent of prior strokes.

The prevalence of pre-stroke dementia is substantially lower in our study compared to other reports in the literature, which suggests likely underestimation and indicates the need for more extensive cognitive screening in the stroke population in China. However, it may not be practical for a comprehensive screening to take place during acute care when a stroke is the presenting condition. In a study from the UK, incompletion of cognitive tests in the acute stroke setting was primarily attributed to neurological deterioration (16). As such, while the single self-report item on pre-stroke dementia in the CSCA is prone to misclassification, implementing a more extensive questionnaire may lead to higher rates of missingness. An alternative method to determine whether the stroke patient has a history of cognitive impairment or dementia is to ask a family member or caregiver to complete the informant-based AD8 questionnaire (17) or the Informant Questionnaire of Cognitive Decline in the Elderly (18). Systematically identifying pre-stroke cognitive impairment during acute care is an important step in accurately estimating the prevalence of pre-stroke dementia in China, which will inform healthcare policy in the face of population aging trends and the increasing burden of dementia.

In our study, patients with pre-stroke dementia were older and more likely to be female. This is consistent with what has been reported in the literature (10) and may be attributed to survival bias, since women have longer life expectancies than men on average and dementia is typically diagnosed in later years (19,20). A smaller proportion of those with pre-stroke dementia received IV tPA within 4.5 hours, which is consistent with findings from an Australian study (21). The lack of adherence may be due to barriers in patients' ability to describe their symptoms to clinicians, but it is unclear why this barrier did not impact other metrics. The relatively smaller proportion of patients with pre-stroke dementia (compared to the proportion without pre-stroke dementia) who received weight loss-related health education at discharge may be due to older age, which is associated with frailty and lower body-mass index (22). Future research and policy efforts should aim to increase the proportion of pre-stroke dementia patients who receive IV tPA within 4.5 hours of stroke onset.

Our findings are consistent with evidence in the literature showing that patients with pre-stroke dementia have worse

in-hospital outcomes, including more complications, higher mortality rates, and a higher likelihood of being institutionalized rather than discharged home (17). Notably, we found that there was no association between pre-stroke dementia and adherence to evidence-based care on a majority of the nationally-standardized performance metrics, despite finding that those with pre-stroke dementia were less likely to ambulate by day 2, more likely to have in-hospital complications, and more likely to die in the hospital compared to those without pre-stroke dementia. This suggests that the patients with pre-stroke dementia may need a different set of metrics for adequate in-hospital treatment and that additional measures should be taken to prevent complications such as pneumonia (i.e., the most prevalent complication in our study). However, prior research showed that while the safety profile of in-hospital treatment for those with pre-stroke dementia or cognitive impairment is inferior to that of cognitively normal patients, the benefit exceeds the risk of treating them the same way as patients without pre-stroke dementia (17). Alternatively, patients with pre-stroke dementia may be less able to advocate for their own care needs during hospitalization due to communication barriers arising from pre-existing cognitive impairment, which may explain the significantly worse in-hospital outcomes despite having received similar treatment. Further research is needed to determine the best course of action for in-hospital treatment for patients with pre-stroke dementia, and whether a different care pathway or additional attention from clinicians is necessary.

In our study, 1.1% of the participants received post-stroke depression, which is markedly lower than what has been reported in prior studies. Post-stroke depression is one of the most common conditions to arise after a stroke event and has been estimated by the American Heart Association to affect one-third of all stroke survivors (23). Even when considering only the studies that measured post-stroke depression within seven days of admission, the lowest rate reported was 16% (24). The discrepancies between our findings and that of other studies may be attributed to the under-diagnosis of depression in China (25). This is significant because post-stroke depression is associated with higher risk of suboptimal recovery, worse quality of life and higher risk of mortality (23), all of which may be exacerbated in those with pre-stroke dementia as depression may be a prodromal stage of dementia (26). Future stroke registries in China should aim to extensively screen patients for post-stroke depression and to prescribe antidepressants accordingly.

Our study has several important strengths. Pre-stroke dementia has not been extensively studied in China. We present in this paper an extensive description of demographics, clinical characteristics, in-hospital treatment and in-hospital outcomes comparing those with and without pre-stroke dementia. The CSCA is the largest and most up-to-date registry of patients who are hospitalized with acute stroke in China. This dataset includes patients from all provinces in China and is probably the best available nationally-representative sample, with a data entry system that has built-in automated checks to identify erroneous entries, although it should be noted that no sampling frame was designed and participation was voluntary. This dataset provided a sufficiently large sample size to study patients with pre-stroke dementia, even with a very small prevalence in the population.

The primary limitation of our study was the retrospective and self-reported nature of the pre-stroke dementia variable, which may have high sensitivity but low specificity as evidenced by the lower estimated prevalence of pre-stroke dementia in this study compared to prior studies. The omission of patients who have dementia but were not identified through self-report may have led to a stronger association between pre-stroke dementia and adverse in-hospital outcomes, since the group defined as having pre-stroke dementia likely consisted of the most severe cases. Given the public health importance of dementia in the aging population in China, future studies should aim to better identify patients with a history of dementia. Findings should additionally be confirmed in studies that prospectively collect data on dementia and stroke. Another limitation was the lack of information on pre-stroke dependence, which is typically measured using the modified Rankin Scale. This metric is highly predictive of in-hospital outcomes and is likely associated with pre-stroke dementia, since those with cognitive impairment are more likely to be functionally dependent (27). As such, this may be an unmeasured confounder in the relationship between pre-stroke dementia and in-hospital outcomes. This limitation was partly mitigated by including NIHSS in our adjusted models as a proxy for function at admission.

Conclusions

In conclusion, our study showed that pre-stroke dementia was associated with lower odds of ambulating by day 2 as well as higher odds of complications and in-hospital mortality, despite similar rates of adherence to most metrics

for evidence-based care. Given the scarcity of prior evidence on how pre-existing dementia affects the prognoses and outcomes of stroke patients in China, these data collected as part of a national, hospital-based quality improvement initiative provide valuable information for clinical decision-making and healthcare policy. Stroke registries should aim to extensively screen patients' cognitive function as soon as possible after the stroke event. This may consist of interviewing proxies, such as family members or caregivers, for those who are unable to undergo screening due to neurological deficits from the stroke. Furthermore, hospital systems may consider developing a different set of indicators for adequate in-hospital treatment for patients with pre-stroke dementia, as they appear to be at higher risk of adverse outcomes than those without post-stroke dementia even with similar adherence to metrics for evidence-based care. A targeted approach for this subgroup of stroke patients is particularly important as the number of persons with both dementia and stroke increases in the aging population in China.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-723/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-723/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics board of Beijing Tiantan Hospital (approval number: KY2018-061-02) and Participating hospitals received either research approval to collect data without requiring individual informed consent under the common rule or a waiver of authorization and exemption from the hospital's Institutional Review Board.

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