Journal of the Neurological Sciences 378 (2017) 80–84

Contents lists available at ScienceDirect

Journal of the Neurological Sciences

journal homepage: www.elsevier.com/locate/jns

Trends in vascular risk factors, stroke performance measures, and outcomes in patients with first-ever ischemic stroke in Taiwan between 2000 and 2012

Cheng-Yang Hsieh [a], Darren Philbert Wu [b], Sheng-Feng Sung [b,*]

[a] Department of Neurology, Tainan Sin Lau Hospital, Tainan, Taiwan
[b] Division of Neurology, Department of Internal Medicine, Ditmanson Medical Foundation Chiayi Christian Hospital, Chiayi City, Taiwan

ARTICLE INFO

Article history:
Received 17 March 2017
Accepted 1 May 2017
Available online 02 May 2017

Keywords:
Claims data
Ischemic stroke
Outcomes
Quality of care
Risk factors

ABSTRACT

Background: With the aging of the population in Taiwan, the financial burden of stroke on the healthcare system is expected to rise. We aimed to investigate the trends in vascular risk factors, adherence to stroke performance measures, and stroke outcomes based on a nationwide representative sample.
Methods: Adult patients hospitalized for first-ever ischemic stroke between 2000 and 2012 were identified from a nationwide administrative database. The study period was divided into 1-year intervals. The Cuzick test and the Cochran-Armitage test were used to determine the significance of changes over time. Trends in stroke outcomes as a function of year were assessed using logistic regression, controlling for age, sex, comorbidity, and stroke severity.
Results: A total of 11,462 patients (mean age 67.3 years, female 40.9%) were hospitalized. Between 2000 and 2012, the prevalence of hypertension, diabetes mellitus, hyperlipidemia, and atrial fibrillation increased while the prevalence of coronary artery disease decreased. The proportion of patients taking antihypertensive or antidiabetic medication prior to stroke decreased, whereas the proportion of patients taking lipid lowering medication increased. Adherence to the five selected performance measures significantly improved. A significant decreasing trend in the proportion of recurrent stroke or all-cause death within one year was observed regardless of whether adjustment for age, sex, comorbidity, and stroke severity was made.
Conclusions: Despite the rising prevalence of vascular risk factors, improved adherence to stroke performance measures was accompanied by better stroke outcomes.

1. Introduction

Stroke remains a leading cause of death and disability worldwide [1]. Patients who have had a stroke are at a high risk for stroke recurrence [2], and the risk of recurrence is positively correlated with the number of vascular risk factors [3]. As the population ages, the financial burden of stroke on the healthcare system is expected to rise, and therefore, stroke remains a tremendous public health challenge. In facing this situation, the surveillance of vascular risk factors, quality of stroke care, interventions to prevent stroke recurrence, and outcomes of stroke patients over time is essential for policy makers and health care authorities. These observations help guide resource allocation, design and implement strategies for stroke prevention, and evaluate the effectiveness of health planning.

Administrative databases are widely used for stroke research and surveillance [4]. Such databases have the advantages of a large sample size, broad coverage of geographic areas, and a prolonged period of observation. In Taiwan, virtually the entire population is enrolled in the compulsory, single-payer National Health Insurance (NHI) program. The NHI program offers affordable and equitable healthcare plans to its residents and covers inpatient care, emergency care, ambulatory care, dental care, and prescription medications. Therefore, the NHI claims database, the Nation Health Insurance Research Database (NHIRD), provides a wealth of information and is particularly suitable for surveillance. However, the information collected and case definitions should be rigorously validated to support the use of this database for longitudinal surveillance.

Previously, administrative case definitions for ischemic stroke and its related vascular risk factors have been validated in the NHIRD [5–7]. In addition, algorithms were developed specifically to estimate stroke severity in patients with ischemic stroke in the NHIRD [8]. Using these validated methods, we aimed to evaluate temporal trends in vascular risk factors and their pre-stroke treatment, stroke

* Corresponding author at: Division of Neurology, Department of Internal Medicine, Ditmanson Medical Foundation Chia-Yi Christian Hospital, 539 Zhongxiao Road, East District, Chiayi City 60002, Taiwan.
E-mail address: 02442@cych.org.tw (S.-F. Sung).

http://dx.doi.org/10.1016/j.jns.2017.05.002
0022-510X/

performance measures, and outcomes in Taiwanese patients with ischemic stroke through analysis of data from the NHIRD.

2. Methods

2.1. Data source

This was a retrospective study using a subset of the NHIRD, the Longitudinal Health Insurance Database 2000 (LHID2000), which contains all the original claims data from 1997 to 2013 of one million subjects randomly sampled in the year 2000 from the 23.8 million enrollees of the NHI program. Because patient identifiers in the LHID2000 have been scrambled to protect privacy, this study was exempt from a full review by the Institutional Review Board of Ditmanson Medical Foundation Chia-Yi Christian Hospital and informed consent was deemed unnecessary.

2.2. Study population

Patients hospitalized for ischemic stroke (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] codes 433.xx and 434.xx) between 2000 and 2012 were enrolled. The above codes have been used to identify cases with ischemic stroke with a sensitivity of 94.5% to 97.3% and a positive predictive value (PPV) of 88.4% to 97.8% [5,6]. For patients with more than one stroke hospitalization within the study period, only the first one was included and designated as the index hospitalization. The date of admission was defined as the index date. Transfers to other acute care hospitals were merged with the initial hospitalization. Patients with previous stroke, defined as having an ICD-9-CM code of 430 to 434, 436, or 438 in previous inpatient or outpatient claims records from 1997 until before the index hospitalization, were excluded. Patients younger than 20 years old and those whose claims items could not be extracted from the LHID2000 were also excluded.

2.3. Patient characteristics

Baseline demographic data was extracted from the LHID2000. We obtained all diagnosis codes from the inpatient and outpatient claims in the one-year lookback period, and secondary diagnosis codes from the index hospitalization claims. Patients were determined to have a specific comorbidity if a corresponding ICD-9-CM code (Supplementary Table 1) was listed in the index hospitalization claims, in at least one prior inpatient claim, or in at least 2 prior outpatient claims [7]. In addition, patients who were prescribed lipid-lowering medication, identified by the Anatomic Therapeutic Chemical (ATC) code C10, were diagnosed with hyperlipidemia [7]. These algorithms have been validated for identifying vascular risk factors including hypertension (sensitivity 90.6%, PPV 89.0%), diabetes (sensitivity 94.8%, PPV 87.8%), hyperlipidemia (sensitivity 77.0%, PPV 81.8%), coronary artery disease (sensitivity 67.9%, PPV 44.7%), and atrial fibrillation (sensitivity 71.1%, PPV 71.2%) [7].

A modified version of the Charlson comorbidity index (CCI) was used to account for comorbidity [9]. Because the LHID2000 does not contain data on clinical stroke scales, a validated proxy for stroke severity, the stroke severity index (SSI), was used to estimate patient stroke severity. The SSI comprises seven claims items including airway suctioning, bacterial sensitivity test, general ward stay, intensive care unit stay, nasogastric intubation, osmotherapy, and urinary catheterization, which can be readily extracted from the index hospitalization claims [8]. The SSI correlated with admission stroke severity, as assessed using the National Institutes Health Stroke Scale with a Pearson correlation coefficient of 0.742 [8] and improved case-mix adjustment of mortality models in patients with ischemic stroke [10,11].

Pre-stroke treatment was identified using ATC codes for antihypertensive drugs (C02, C03, C07, C08, C09), antidiabetic drugs (A10), lipid lowering medication (C10), antiplatelet agents (B01AC), and oral anticoagulants (B01AA, B01AE, B01AF) from prescription claims within three months before the index date.

2.4. Performance measures

To improve the quality of stroke care, professional guidelines have been developed to facilitate the delivery of evidence-based care. Based on the guidelines, performance measures were created to quantify the quality of stroke care [12]. Five performance measures were investigated as follows: if the patient was discharged on antithrombotic therapy, use of anticoagulation therapy for atrial fibrillation, treatment with thrombolytic therapy, if the patient was discharged on statin medication, and whether the patient was assessed for rehabilitation. Supplementary Table 2 lists the definitions of the performance measures, which were modified to adapt to the limited information in claims data. For example, the denominator of thrombolytic therapy included all ischemic stroke patients instead of those eligible for intravenous thrombolytic therapy. The denominator of discharged on statin medication included patients diagnosed with hyperlipidemia rather than those with an elevated low-density lipoprotein cholesterol. The numerator of anticoagulation therapy for atrial fibrillation was expanded to include patients who were prescribed anticoagulant during outpatient office visits after discharge within 30 days of the index date because initiation of oral anticoagulant may be delayed in patients with moderate to large brain infarction.

2.5. Stroke outcomes

The primary outcome of interest was a composite outcome defined as recurrent stroke or all-cause death within one year after the index date. Recurrent stroke and all-cause death were also examined separately as secondary outcomes.

Recurrent stroke was defined as a readmission to an acute care hospital with a principal diagnosis of acute stroke (ICD-9-CM code of 430 to 434, or 436). Vital status was determined per a validated algorithm [13]. In addition, out-of-hospital death was determined by identifying the record of disenrollment from the NHI program because the main reason for disenrollment is death [10]. The other reasons for disenrollment, i.e. moving overseas, being jailed for 2 months or more, and being missing for 6 months or more, are highly unlikely for stroke survivors.

2.6. Statistical analysis

We reported continuous variables with means (standard deviations) or medians (interquartile ranges), and categorical variables with counts and percentages. The Cuzick test for trend was used to determine the significance of changes over time in continuous variables and the Cochran-Armitage test for trend was used in binary variables. Trends in the stroke outcomes were assessed using logistic regression with year entered as a continuous variable, controlling for age, sex, and modified CCI. Because stroke severity is a major determinant of stroke outcomes [14,15], a separate logistic regression was performed controlling for age, sex, modified CCI, and SSI.

Two-tailed P values < 0.05 were considered statistically significant. Statistical analyses were performed using Stata 13.1 (StataCorp, College Station, Texas).

3. Results

We identified 11,462 adult patients with first-ever ischemic stroke between 2000 and 2012. After excluding 44 patients with missing data, the study population consisted of 11,418 patients. Table 1 lists the characteristics of these patients. The mean age was 67.3 and 40.9% were woman. The prevalence of hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, and atrial fibrillation was 72.0%,