

Impact of Multiple Chronic Conditions in Patients Hospitalized with Stroke and Transient Ischemic Attack

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Background: The prevalence and clinical impact of chronic conditions (CCs) have increasingly been recognized as an important public health concern. We evaluated the prevalence of coexisting CCs and their association with 30-day mortality and readmission in hospitalized patients with stroke and transient ischemic attack (TIA). **Methods:** In a retrospective study of patients aged ≥ 18 years hospitalized for first-ever stroke and TIA, we assessed the prevalence of coexisting CCs and their predictive value for subsequent 30-day mortality and readmission. **Results:** Study cohort comprised 6771 patients, hospitalized for stroke ($n = 4068$) and TIA ($n = 2703$), 51.4% men, with mean age of 68.2 years (standard deviation: ± 15.6), mean number of CCs of 2.9 (± 1.7), 30-day mortality rate of 8.6% (entire cohort), and 30-day readmission rate of 9.7% (in 2498 patients limited to Olmsted and surrounding counties). In multivariable models, significant predictors of (1) 30-day mortality were coexisting heart failure (HF) (odds ratio [OR]: 1.45, 95% confidence interval [CI]: 1.09-1.92), cardiac arrhythmia (OR: 1.74, 95% CI: 1.40-2.17), coronary artery disease (CAD) (OR: 1.64, 95% CI: 1.29-2.08), cancer (OR: 1.67, 95% CI: 1.31-2.14), and diabetes (HR: 1.28, 95% CI: 1.01-1.62); and (2) 30-day readmission ($n = 2498$) were CAD (OR: 1.50, 95% CI: 1.09-2.07), cancer (OR: 1.46, 95% CI: 1.01-2.10), and arthritis (OR: 1.62, 95% CI: 1.09-2.40). **Conclusions:** In patients hospitalized with stroke and TIA, CCs are highly prevalent and influence 30-day mortality and readmission. Optimal therapeutic and lifestyle interventions for CAD, HF, cardiac arrhythmia, cancer, diabetes, and arthritis may improve early clinical outcome. **Key Words:** Trend—stroke—chronic condition—mortality—readmission.

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Stroke and transient ischemic attack (TIA) are the leading causes of hospitalization, readmission, and excess mortality in the United States^{1,2} and worldwide.^{3,4} TIA is a medical emergency and associated with a high short-term risk of stroke, cardiovascular events, and death.⁵ A third of patients with TIA, indeed, have an acute cerebral infarct detected by magnetic resonance imaging.⁶ TIA and ischemic stroke represent a continuum of acute ischemic cerebrovascular syndrome.^{1,7} Therefore, it is reasonable to investigate both TIA and stroke as a combined heterogeneous cohort. Increasing prevalence of individual and multiple chronic conditions (MCC) among U.S. adults is currently a major public health concern and prompted a great deal of attention in recent years.⁸ Data from the 2010 National Health Interview Survey ascertained that

approximately 26% of U.S. adults had MCC.⁹ However, the prevalence and implication for early clinical outcomes of coexisting individual or MCC in patients with first-ever stroke and TIA are not well understood. Although numerous population-based studies have focused on risk factors for initial stroke and TIA, research on subsequent clinical events is limited. Specifically, no study has reported association between individual or MCC and short-term clinical outcomes after index hospitalization for stroke and TIA. Understanding the prevalence of chronic conditions (CCs) and their impact on clinical outcome in patients with stroke and TIA provides an opportunity to improve patient care.

Therefore, in a broader hospitalized stroke and TIA patient population, we attempted to evaluate the prevalence of simultaneously coexisting single and MCC to determine whether these conditions have any impact on 30-day all-cause mortality and all-cause readmission after initial stroke and TIA.

Methods

Study Design and Population

This is a retrospective study of patients aged ≥ 18 years hospitalized for first-ever stroke and TIA at Mayo Clinic Hospital, Rochester, Minnesota, a comprehensive stroke center, from January 2005 to August 2015. The look-back period extended to approximately 10 years to ensure validity of first-ever event. The data were extracted by dedicated abstraction personnel using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes. Previous studies have demonstrated a high positive predictive value of ICD-9-CM codes for the discharge diagnoses of stroke and TIA.^{10,11} Stroke was subtyped according to Stroke Data Bank scheme¹² as (1) ischemic stroke (cardioembolic and non-cardioembolic ischemic stroke), (2) primary intracerebral hemorrhage (PICH), and (3) subarachnoid hemorrhage (SAH). Spinal cord stroke and cerebral venous thrombosis-related strokes were excluded due to rarity. The diagnoses of stroke and TIA were based on physician provider as documented in clinical notes. Patients who refused participation in clinical research were excluded. The study was approved by the Mayo Clinic Institutional Review Board.

Measures of CCs

Chronic condition is defined as a long-term condition requiring medical attention.¹³ Twenty CCs specified by the Office of the Assistant Secretary for Health¹³ were initially selected for the present study. Because the cohort was defined by first-ever stroke, stroke was excluded from the list of 20 CCs. The presence or absence of the remaining 19 conditions was identified using Clinical Classifications Software codes. These are codes that group ICD-9-CM codes and are part of the U.S. Healthcare Cost

and Utilization Project (H-Cup) tool. The prevalence of MCC was estimated by the proportion of patients with 2 or more coexisting CCs. Prevalent CCs were further categorized into 4 levels based on the number of coexisting CCs: <2, 2, 3, and 4+.

Measures of Outcome

Co-primary outcomes included prevalence of coexisting CCs, estimates of death from any cause within 30 days of a date of hospital admission, and 30-day readmission from any cause from date of discharge. Mortality statistics were performed for the entire cohort, regardless of zip codes, whereas readmission rates were calculated in a targeted patient population restricted to Olmsted and immediate surrounding counties to minimize underestimation of true rates of subsequent rehospitalizations.

Statistical Analysis

Descriptive data were summarized as mean (standard deviation) for continuous variables and frequency (percent) for categorical variables. Men and women and young (<65 years) and older (≥ 65 years) participants were compared by chi-square test for categorical variables, and 2-sample Student *t*-test for continuous variables. To assess the effect of CCs on clinical outcomes, we fit logistic regression models that included selected CCs, plus sociodemographic factors and stroke subtype. In addition to models that included all CCs, we fit models that used the number of CCs instead. The results are presented as odds ratios (OR) and 95% confidence interval (CI).

Results

The study cohort comprised 6771 patients who were first hospitalized with a primary discharge diagnosis of stroke ($n = 4068$, 60.1%) and TIA ($n = 2703$, 39.9%); 51.4% were men and 92.7% were white. [Tables 1 and 2](#) illustrate the baseline characteristics by age, sex, and stroke subtypes for the entire patient population and those restricted to Olmsted and immediate surrounding counties, respectively. In overall patient population, the mean age was 68.2 ± 15.6 years and the male-to-female ratio was 1.1:1 (51.4%-48.6%). Of the 19 selected CCs, autism, hepatitis, HIV, and schizophrenia were excluded from the analysis for <1% co-occurrence with stroke and TIA. We incorporated sociodemographics and 15 distinct coexisting CCs in logistic regression models to assess the risk for death and readmission from any cause by 30 days after index hospitalization. Overall 30-day mortality was 8.6%, lowest for TIA (.6%) and highest for PICH (28.6%). We ascertained 30-day readmission rate in a sample of patients restricted to Olmsted and immediate surrounding counties ($n = 2498$) because of concern about underrating true rates of readmission if wider

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