Cardiac Arrest in Acute Ischemic Stroke: Incidence, Predisposing Factors, and Clinical Outcomes

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Background: Cardiac arrest is a devastating complication of acute ischemic stroke, but little is known about its incidence and characteristics. We studied a large ischemic stroke inpatient population and compared patients with and without cardiac arrest. *Methods:* We studied consecutive patients from the Ontario Stroke Registry who had an ischemic stroke between July 2003 and June 2008 at 11 tertiary care stroke centers in Ontario. Multivariable analyses were used to determine independent predictors of cardiac arrest and associated outcomes. Adjusted survival curves were computed, and hazard ratios for mortality at 30 days and 1 year were determined for cardiac arrest and other major outcomes. *Results:* Among the 9019 patients with acute ischemic stroke, 352 had cardiac arrest, for an overall incidence of 3.9%. In a sensitivity analysis with palliative patients removed, the incidence of cardiac arrest was 2.5%. Independent predictors of cardiac arrest were as follows: older age, greater stroke severity, preadmission dependence, and a history of diabetes, myocardial infarction, congestive heart failure, and atrial fibrillation. Systemic complications associated with cardiac arrest were as follows: myocardial infarction, pulmonary embolism, sepsis, gastrointestinal hemorrhage, and pneumonia. Patients with cardiac arrest had higher disability at discharge, and a markedly increased 30-day mortality of 82.1% compared with 9.3% without cardiac arrest. *Conclusions:* Cardiac arrest had a high incidence and was associated with poor outcomes after ischemic stroke, including multiple medical complications and very high mortality. Predictors of cardiac arrest identified in this study could help risk stratify ischemic stroke patients for cardiac investigations and prolonged cardiac monitoring. **Key Words:** Ischemic stroke—cardiac arrest—outcomes and process measures—stroke complications.

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Introduction

Cardiac arrest (CA) may occur unexpectedly after an acute ischemic stroke. Cardiac complications after stroke span a wide range and include acute myocardial infarction (MI), bradyarrhythmia and tachyarrhythmia, congestive heart failure (CHF), and CA. Patients with pre-existing cardiac disease have a higher rate of cardiac events post stroke.[1] However, even among those patients without overt heart disease, 20%-40% can develop silent myocardial ischemia after stroke.[2] Most bradyarrhythmias and tachyarrhythmias occur soon after stroke, with 74% of all arrhythmias detected within 24 hours of admission[3]; one fourth of these arrhythmias required urgent evaluation and treatment. Poststroke arrhythmias are hypothesized to result from abnormalities in autonomic control, causing release of catecholamines and dysregulated blood pressure and heart rate, particularly with insular lesions.[4]

Overall, 19% of ischemic stroke patients experience a serious adverse cardiac event,[1] peaking between day 2 and day 3. In the first 1-2 weeks, cardiac death is the second most common cause of death of stroke after neurological causes,[1,5] with a maximal rate at day 14.[1] At 4 years, 7% of stroke patients have died of a primary cardiac cause.[6]

Despite the importance of CA, there is no large study to date identifying the incidence, patient characteristics, risk factors, outcomes, and overall impact of CA after stroke. Therefore, we conducted a registry-based study using the Ontario Stroke Registry (OSR) to identify patients who had suffered from "cardiac or respiratory arrest" after admission for stroke.

The objectives of our study were as follows: (1) to determine the prevalence of CA in patients admitted to a tertiary care center after ischemic stroke; (2) to identify differences in baseline characteristics that may predispose to CA, and compare factors and outcomes associated with CA in patients admitted with ischemic stroke; and (3) to compare mortality between ischemic stroke patients with and without CA.

Methods

We conducted a retrospective observational study using the OSR, a clinical database including patients who have experienced an acute stroke and admitted to the participating institutions. Participants were included in the study if they were admitted to any of 11 regional stroke centers in the province of Ontario, Canada, with first acute ischemic stroke between July 2003 and June 2008. The OSR was previously known as the Registry of the Canadian Stroke Network; further details can be obtained online.[7]

The study exclusion criteria were as follows: in-hospital stroke, age less than 18 years, and stroke onset to emergency department arrival over 72 hours. All centers are considered comprehensive or primary stroke centers. Patients with designation for palliative care, comfort measures, or do not resuscitate prior to the admission were excluded. Data were linked with the Registered Persons Database, which contains demographic information and vital status, to obtain long-term mortality.

Baseline Characteristics

The following information was collected and assessed for differences between groups: demographics (age, gender, previous location, and preadmission independence), pre-existing medical conditions (including hypertension; hyperlipidemia; atrial fibrillation; previous angina, MI, coronary revascularization, CHF; diabetes; smoking; cancer; prior stroke or transient ischemic attack; Charlson comorbidity index), preadmission medications (antiplatelet, anticoagulant, and statin), acute treatment (thrombolysis), and stroke severity (based on the National Institutes of Health Stroke Scale [NIHSS] and Canadian Neurological Scale [CNS] scores). Stroke severity by CNS was categorized as mild (CNS >8), moderate (CNS 5-7), or severe (CNS <4). A CNS score of greater than or equal to 8 is equivalent to an NIHSS score of less than or equal to 8 (mild); a CNS score of 5-7 is equivalent to an NIHSS score of 9-13 (moderate); a CNS score of 1-4 is equivalent to an NIHSS score of 14-22 (severe); and a CNS score of 0 is equivalent to an NIHSS score of greater than or equal to 23. Stroke type was classified based on the TOAST (Trial of ORG 10172 in Acute Stroke Treatment) criteria[8]: small vessel disease, cardioembolic, large artery atherosclerotic disease, or undetermined etiology. Patients were also classified based on admission to general ward, intensive care unit (ICU), or stroke unit, where stroke unit was defined as designated ward where care was provided specifically to stroke patients by a multidisciplinary team.

Definition of Cardiac Arrest

Cardiac arrest is an independent variable captured by the OSR database, defined as "cardiac or respiratory arrest within 30 days of admission for the hospital stay that was documented by a physician and identified from resuscitation records, progress reports, or consultant notes." Data abstractors were also instructed to code for this variable when patients suffered sudden and unexpected death.

Main Outcome Measures

The primary outcome was 30-day mortality. Secondary outcomes included 1-year mortality, medical complications during hospitalization (i.e., MI, pulmonary embolism, gastrointestinal [GI] hemorrhage, sepsis, and pneumonia), modified Rankin Scale (mRS) score at discharge, and location of discharge.