Clinical Outcomes after Thrombectomy for Acute Ischemic Stroke on Weekends versus Weekdays

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Background: The objective of this study was to determine whether clinical outcomes differed in acute ischemic stroke (AIS) patients who underwent thrombectomy on weekends versus weekdays. *Methods:* Patients with a primary diagnosis of AIS who underwent thrombectomy were identified from the Nationwide Inpatient Sample from 2005 to 2011 and stratified according to weekend or weekday admission. Logistic regression analysis was performed to identify factors associated with moderate-to-severe disability at hospital discharge in teaching and nonteaching hospitals. *Results:* Of 12,055 patients with AIS who underwent thrombectomy during the study period, 2862 (23.7%) were admitted on a weekend. In a multivariate logistic regression analysis, factors associated with moderate or severe disability at discharge in nonteaching hospitals were weekend admission (odds ratio [OR], 1.6; 95% confidence interval [CI], 1.0-2.8; $P = .04$), diagnosis of hypertension (OR, 1.9; 95% CI, 1.0-3.6; $P = .05$), and Medicare or Medicaid insurance status (OR, 2.1; 95% CI 1.1-4.3; $P = .02$); factors associated with moderate or severe disability at discharge in teaching hospitals were age >70 years (OR, 1.5; 95% CI, 1.1-2.2; $P = .02$), pneumonia (OR, 4.7; 95% CI, 2.2-10.2; $P < .0001$), sepsis (OR, 8.2; 95% CI, 1.2-54.8; $P = .03$), intracranial hemorrhage (OR, 3.3; 95% CI, 1.8-6.1; $P = .0001$), and treatment in a Northwest hospital region (OR, 1.7; 95% CI, 1.2-2.4; $P = .03$). *Conclusions:* AIS patients undergoing thrombectomy who were admitted to nonteaching hospitals on weekends were more likely to be discharged with moderate-to-severe disability than those admitted on weekdays. No weekend effect on discharge clinical outcome was seen in teaching hospitals. **Key Words:** All cerebrovascular disease/stroke—harm/risk analysis—infarction—weekend effect—thrombectomy—endovascular therapy.

Introduction

Prior studies have demonstrated differences in the quality of care and clinical outcomes in stroke patients admitted on weekends versus weekdays. In the United States, studies have found a "weekend effect" associated with significant increases in mortality in the first week and the first 90 days after stroke.[1-4] Other US studies have found an increase in frequency of thrombolytic use in patients presenting on the weekend with no difference in mortality or discharge disposition compared with weekday presentation.[5] In a United Kingdom study, patients presenting on the weekend were less likely to receive thrombolysis than on a weekday; however, studies from Germany and Taiwan found an increased frequency of thrombolytic use in patients presenting on a weekend.[6-9]

There has been limited data evaluating the weekend effect on outcomes among patients who have undergone thrombectomy in the treatment of acute ischemic stroke

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Received February 17, 2014; revision received April 7, 2014; accepted June 15, 2014.

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1052-3057/$ - see front matter

http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2014.06.006

(AIS). Given the importance of time to reperfusion on clinical outcomes, we hypothesized that a weekend effect may be seen in clinical outcomes at discharge in AIS patients undergoing thrombectomy.

Methods

Data from the National Inpatient Sample (NIS) from 2005 to 2011 were used for this analysis. A comprehensive synopsis on NIS data is available at http://www.hcup-us.ahrq.gov.

We used the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) primary diagnosis codes 433-434 to identify patients admitted with ischemic stroke. We also used ICD-9-CM procedure codes to identify mechanical thrombectomy (39.74 and Medicare severity diagnosis-related group code 543) and cerebral angiography (88.41). Any patient who had an ICD-9 code of mechanical thrombectomy and subsequent code of cerebral angiography was selected as a patient who received thrombectomy. Patients were categorized as having been admitted on weekends (Saturday or Sunday) versus weekdays (Monday through Friday), a distinct variable in the NIS database that is, calculated from the original admission date. The NIS database does not allow identification of specific admission hours. Patients with missing data regarding the day of admission were excluded.

Study Variables

The analysis included age, sex, race/ethnicity, and comorbidities obtained from the Agency for Healthcare Research and Quality comorbidity data files including congestive heart failure, diabetes mellitus, hypertension, alcohol abuse, renal failure, and chronic lung disease. We used ICD-9-CM secondary diagnosis codes to identify comorbid atrial fibrillation (427.30 and 427.31), dyslipidemia (272.0-272.9), nicotine dependence (305.1), and stroke-associated complications such as pneumonia (486, 481, 482.8, and 482.3), urinary tract infection (599.0, 590.9), sepsis (995.91, 996.64, 038, 995.92, and 999.3), deep venous thrombosis (451.1, 451.2, 451.81, 451.9, 453.1, 453.2, 453.8, and 453.9), pulmonary embolism (415.1), myocardial infarction (410.0-410.9), and intracerebral hemorrhage (431-432). We also used ICD-9-CM procedure codes to determine the frequency of stroke patients who underwent tracheostomy (31.10, 31.20, 31.21, or 31.29), mechanical ventilation (9672), transfusion (99.04), carotid angioplasty/stent placement (00.63/00.64), carotid endarterectomy (38.12), intubation (96.04), gastrostomy (431.1-431.9), and thrombolytic administration (99.10).

Severity of patient illness was defined using the All Patient Refined Diagnosis Related Groups, which determines severity of illness based on the extent of physiologic decompensation or organ system loss of function. The data elements used by the All Patient Refined Diagnosis Related Groups are based on primary and secondary ICD-9-CM diagnoses codes, procedures codes, age, sex, and discharge disposition. These data elements were combined on a patient-specific basis to determine a patient's severity of illness.

The admitting hospitals were classified as teaching or nonteaching and were further characterized into small, medium, and large size based on available hospital beds. Teaching hospitals were defined as those which have an American Medical Association–approved residency program or have membership in the Council of Teaching Hospitals. A teaching hospital was defined as one that meets at least one of the following 3 criteria: residency training approval by the Accreditation Council for Graduate Medical Education, membership in the Council of Teaching Hospitals, and a ratio of full-time equivalent interns and residents to beds of .25 or higher.[10] Small-, medium-, and large-sized categories were based on hospital beds, and thresholds for stratification were based on hospital location and teaching status. For example, the definition of large size may vary from exceeding 325 to exceeding 450 acute hospital beds depending on the location and characteristics of the hospital. Other hospital factors evaluated were geographic region in the United States (Northeast, Midwest, West, and South), length of stay, and hospital charges.

Study End Points

We included neurologic complication, cardiac complication, postoperative mortality, and a composite end point. Neurologic complications were identified by specific ICD-9-CM code (997.00-997.09), which includes iatrogenic cerebral ischemic complication or intracranial hemorrhage. We also used ICD-9-CM diagnostic codes for the identification of cardiac complications (997.10), which include cardiac arrest, insufficiency, or failure during or as a result of a procedure. The composite end point was defined as any patient who had a neurologic complication, cardiac complication, or postoperative mortality.

Discharge status was categorized into routine, home health care, short-term hospital, other facility including intermediate care and skilled nursing home, or death in the NIS. We categorized routine discharge as none to minimal disability and all other discharge status as moderate to severe disability as previously described.[11]

Statistical Analysis

The SAS 9.3 software (SAS Institute, Cary, NC) was used to convert NIS database data into weighted counts to generate national estimates following Healthcare Cost and Utilization Project recommendations. We performed chi-square for categorical and t test for continuous variables to identify differences in study variables and end