Comprehensive Stroke Centers
Eliminating an Apparent Disparity in Stroke Care on Weekends Versus Weekdays?

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A growing body of literature has highlighted a significant discrepancy in outcomes for patients admitted on weekends versus weekdays for a number of diseases such as acute myocardial infarction,1 congestive heart failure,2 gastrointestinal hemorrhage,3 pulmonary embolism,4 and intracerebral hemorrhage.5 For acute ischemic stroke, the results have been variable with some studies demonstrating a significant difference in outcomes for patients admitted on weekends compared with weekdays6,7 whereas others,8 including a recent study using the Nationwide Inpatient Sample Database,9 failed to demonstrate a difference. Up to this point, much of this work has focused on early or in-hospital mortality and there is a paucity of data concerning longer-term outcomes examining a potential weekend effect. Additionally, previous work has noted that this weekend effect may have diminished over time10; this observation has been ascribed to a potential improvement in stroke care over time. Finally, there have been some data demonstrating that patients admitted to comprehensive stroke centers on the weekends have similar outcomes compared with weekday admissions.11

In the present study, McKinney and colleagues have provided an additional contribution attempting to examine disparities in stroke care dependent on the time of the week admitted. Furthermore, they sought to examine if this potential difference has been mitigated over time through modifications in the organization and delivery of stroke care. The authors have used a database that has several inherent advantages well suited to the aims of their study. They used the Myocardial Infarction Data Acquisition System (MIDAS) administrative database containing demographic and clinical data on patients discharged with a primary diagnosis of cerebral infarction from all nonfederal acute care hospitals in New Jersey. The authors obtained data on out-of-hospital deaths by matching MIDAS records with New Jersey death registration files using validated software in a blinded automated procedure. For the strategic purposes of this study, the state of New Jersey enacted the “Stroke Center Act” in 2004, which designated hospitals that meet certain standards as Primary Stroke Centers (PSC) or Comprehensive Stroke Centers (CSC). The state issued its first certification for both PSC and CSC in 2007.

The MIDAS database included 134,441 patients admitted with a primary diagnosis of cerebral infarction during the study period of 1996 to 2007. Twenty-three point four percent, 51.5%, and 25.1% of patients were admitted to a CSC, PSC, and nonstroke center (NSC), respectively. Mortality 90 days after admission was significantly higher for patients admitted on weekends compared with weekdays (17.2% versus 16.5%, Ps<0.001; as were in-hospital and 30-day mortality rates) and this was found for all time periods assessed throughout the study. After adjusting for potential confounding variables, 90-day mortality remained significantly higher for patients admitted on weekends than for weekdays (hazard ratio, 1.05; 95% CI, 1.02 to 1.09).

McKinney et al also examined use of intravenous thrombolyis as a function of weekend versus weekday admission and as a function of stroke center designation. They found that administration of intravenous thrombolyis was more frequent for patients admitted on weekends compared with weekdays (1.6% versus 1.3%, Ps<0.0001; higher adjusted OR for intravenous tissue plasminogen activator for patients admitted on weekends, OR, 1.19; 95% CI, 1.07 to 1.31). Moreover, the adjusted odds of intravenous tissue plasminogen activator administration was also higher at CSC (OR, 5.82; 95% CI, 4.88 to 6.94) or PSC (OR, 2.48; 95% CI, 2.07 to 2.96) compared with NSC. Compared with the period between 1998 and 1999, patients treated during the period of initial stroke center designation by The Joint Commission (2002 to 2003) and New Jersey state stroke center designation (2006 to 2007) were 4 and 10 times, respectively, more likely to receive intravenous tissue plasminogen activator.

When examining trends for admission to stroke centers versus NSC, weekday versus weekend admissions remained similar in all time periods studied for all hospital types except during the period 2006 to 2007, when patients were more frequently admitted to a CSC on weekends versus weekdays (30.3% versus 26.8%, Ps<0.0001). There was no increase in adjusted 90-day mortality observed in patients admitted to CSC on weekends (hazard ratio, 1.01; 95% CI, 0.95 to 1.08); however, adjusted mortality was greater with weekend admissions to PSC (hazard ratio, 1.06; 95% CI, 1.02 to 1.10) and NSC (hazard ratio, 1.08; 95% CI, 1.02 to 1.15).

This study lends further credence to an apparent discrepancy in stroke care observed on weekends compared with...
weekdays as demonstrated by a higher 90-day mortality (and in-hospital and 30-day mortality) seen in patients with stroke admitted on weekends compared with weekdays throughout the study period. There are multiple possibilities for this discrepancy; however, the most obvious appears to be potentially related to reduced hospital staffing, resources, and infrastructure on weekends compared with weekdays.

An important finding of the present study is the observation that this weekend effect was not observed at hospitals designated as CSC. Again, adjusted 90-day mortality was similar for patients admitted on weekends and weekdays at CSC, whereas an increased 90-day mortality was found for patients admitted on the weekends compared with weekdays at PSC and NSC. Could this finding simply reflect an effect of the volume of patients with stroke managed at CSCs? Although it is possible, it appears unlikely as the authors demonstrate that admission to the highest volume centers was associated with an increased mortality on weekends, whereas CSC was associated with a lower mortality in the multivariable model used. Additionally, recent work demonstrates that patients admitted to designated stroke centers in New York State have a significant reduction in 30-day mortality compared with patients admitted to NSCs after controlling for hospital volume.12 The authors attempted to examine a potential effect of primary stroke center designation on reducing the discrepancy in observed weekend mortality by comparing the period 1996 to 2002 with the period 2003 to 2007 (before and after primary stroke center designation began by The Joint Commission). No significant effect was observed as the weekend effect persisted during both time periods. When comparing the time period 2006 to 2007 (when New Jersey began granting CSC designations) with 1996 to 1997, adjusted 90-day mortality was lower for patients admitted in the period 2006 to 2007 (hazard ratio, 0.86; 95% CI, 0.82 to 0.91). This observation combined with the finding that CSC appears to overcome the discrepancy between 90-day mortality for patients with stroke admitted on weekends compared with weekdays suggests that there is something inherently unique in the organization and delivery of care at these CSC, apparently independent of volume of patients with stroke managed.

Several important points worthy of emphasizing surface from the results presented concerning intravenous tissue plasminogen activator administration. First, the overall rates of intravenous tissue plasminogen activator administration increased 10-fold throughout the duration of this study; this is likely multifactorial but a definite positive step in the treatment of acute ischemic stroke in the state of New Jersey. Second, the rate of intravenous tissue plasminogen activator to patients admitted on the weekend was higher compared with those admitted on weekdays. Previous explanations have been provided for this observation, including more severe strokes on weekends, reduced traffic and work obligations, and more rapid access to imaging and stroke evaluation outside of normal work schedules.6,9 An interesting observation in the present study was that there was an increased presentation to emergency rooms on weekends (ie, less stroke admissions from referring physicians, which may potentially delay access to tissue plasminogen activator) and a higher likelihood of CSC admission; these observations may collectively, at least in part, explain the increased administration of intravenous tissue plasminogen activator to patients with stroke admitted on the weekend.

This study is an important contribution to the stroke literature. The unique database used, large sample size, inclusion of patients with a first-time diagnosis of ischemic stroke, and 90-day mortality outcome measure are significant strengths. There are several limitations that the authors have largely effectively addressed. The retrospective nature of the study introduces the potential for selection bias. The database, although relatively robust, may not have captured potentially confounding variables that may have accounted for some of the observations presented in this study. The authors used the New Jersey death registration files to determine 90-day mortality. Although this captures all in-state deaths, it does not account for out-of-state deaths, which could introduce bias. The authors also applied current stroke center designations to hospitals during the study period, although they may not have delivered CSC-level care during the study period. The period of study included in the present study ended 4 years ago, and further changes in stroke care may have occurred in the interim. Finally, although the authors discussed use of intravenous tissue plasminogen activator, data concerning other acute stroke treatments such as intra-arterial interventions (mechanical or pharmacological), which may be unique to CSC, are not discussed.

The observation that CSCs appear to overcome the apparent discrepancy between weekend and weekday care for patients with acute ischemic stroke has profound implications for our patients and for the future organization and delivery of stroke care. Although it is difficult to make definitive conclusions from a retrospective study, the present work does provide impetus for future investigation. It will be critical to discern the elements responsible for the apparent ability of CSC to standardize stroke care (and outcomes) independent of the day of the week; lessons gleaned from this analysis could then hopefully be applied, at least to some extent, across hospitals that care for patients with stroke. The authors are to be congratulated for this timely work, and we await future contributions from this group (particularly as data emerge from the recently developed prospective New Jersey Acute Stroke Registry) and others that will help to improve our management of patients with acute ischemic stroke.

Disclosures
A.S.D. is a consultant for Microvention, ev3, and Stryker Neurovascular (not relevant to this editorial); P.M.J. is a consultant for Codman Neurovascular (not relevant to this editorial).

References


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