Predictors of Poor Hospital Discharge Outcome in Acute Stroke Due To Atrial Fibrillation

CE 2.0 ANCC Contact Hours

Melissa J. Tian, Ashis H. Tayal, Elizabeth A. Schlenk

ABSTRACT

Atrial fibrillation (AF) is a frequent cause of acute ischemic stroke that results in severe neurological disability and death despite treatment with intravenous thrombolysis (intravenous recombinant tissue plasminogen activator [rtPA]). We performed a retrospective review of a single-center registry of patients treated with intravenous rtPA for stroke. The purposes of this study were to compare intravenous rtPA treated patients with stroke with and without AF to examine independent predictors of poor hospital discharge outcome (in-hospital death or hospital discharge to a skilled nursing facility, long-term acute care facility, or hospice care). A univariate analysis was performed on 144 patients receiving intravenous rtPA for stroke secondary to AF and 190 patients without AF. Characteristics that were significantly different between the two groups were age, initial National Institutes of Health Stroke Scale score, length of hospital stay, gender, hypertension, hyperlipidemia, smoking status, presence of large cerebral infarct, and hospital discharge outcome. Bivariate logistic regression analysis indicated that patients with stroke secondary to AF with a poor hospital discharge outcome had a greater likelihood of older age, higher initial National Institutes of Health Stroke Scale scores, longer length of hospital stay, intubation, and presence of large cerebral infarct compared with those with good hospital discharge outcome (discharged to home or inpatient rehabilitation or signed oneself out against medical advice). A multivariate logistic regression analysis showed that older age, longer length of hospital stay, and presence of large cerebral infarct were independent predictors of poor hospital discharge outcome. These predictors can guide nursing interventions, aid the multidisciplinary treating team with treatment decisions, and suggest future directions for research.

Keywords: atrial fibrillation, hospital discharge outcome, intravenous rtPA, ischemic stroke

Stroke is the fourth leading cause of death in the United States, affecting 795,000 people each year according to the Centers for Disease and Prevention and Prevention (Goldstein & Rothwell, 2012). Ischemic stroke accounts for 87% of all strokes (Go et al., 2013), and cardioembolism resulting from AF is responsible for 15%–20% of ischemic strokes (Centers for Disease Control and Prevention, 2010). Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, and one in four individuals aged 40 years will develop AF during his or her lifetime (You et al., 2012). Ischemic strokes occurring in patients with AF are more severe than in patients without AF (Dulli, Stanko, & Levine, 2003).

Questions or comments about this article may be directed to Melissa J. Tian, MSN RN CCRC, at mtian@wpahs.org. She is a Manager of Neurology Research, Alleghney General Hospital, Pittsburgh, PA.

Ashis H. Tayal, MD, is an Associate Professor and Director of Stroke Program, Alleghney General Hospital, Pittsburgh, PA.

Elizabeth A. Schlenk, PhD RN, is an Associate Professor, University of Pittsburgh School of Nursing, Pittsburgh, PA.

The authors declare no conflicts of interest.

DOI: 10.1097/JNN.0000000000000104

Treatment of Acute Ischemic Stroke

Intravenous recombinant tissue plasminogen activator (rtPA) is a widely accepted treatment for stroke approved by the U.S. Food and Drug Administration since 1996 that improves functional recovery of stroke survivors with no effect on mortality (Lansberg, 2012). The major limitation of this intervention is the narrow treatment window of 0–3 hours from stroke symptom onset. Only 3%–5% of patients experiencing stroke symptoms arrive at a hospital in time to be considered for this treatment (American Stroke Association, 2012a). Delays in seeking medical treatment for stroke can severely limit the treatment options. Poor public unawareness of time-sensitive treatments or patient denial of stroke symptoms may be responsible for the small percentage of patients who arrive to the hospital in time for intravenous rtPA. The probability of a good functional outcome is directly related to shortened time to administration of intravenous rtPA.

Risk Factors and Outcome in Ischemic Stroke

Uncontrollable factors that place a person at risk for stroke include age, gender, race, family history, and prior history of stroke or transient ischemic attack (American Stroke Association, 2012b). The modifiable

risk factors for stroke include hypertension, hyperlipidemia, diabetes mellitus, cigarette smoking, obesity, cardiovascular disease, physical inactivity, and AF (Goldstein et al., 2006). Stroke prevention measures and treatment options for patients with AF should be a high concern for clinicians who treat AF. Among patients with AF, the absolute risk for stroke varies 20-fold depending on patient age and other clinical features (Stroke Risk in Atrial Fibrillation Working Group, 2007).

The National Institutes of Health Stroke Scale (NIHSS) is a validated neurological scale of stroke severity that is standardized and administered by a broad range of healthcare providers (Frankel et al., 2000). Increasing stroke severity based on the admission NIHSS score has been shown to correlate with mortality. Thirty-day mortality rates based on the admission NIHSS are mild stroke (NIHSS of 0–7, 4.2%), moderate stroke (NIHSS of 8–13, 13.9%), severe stroke (NIHSS of 14–21, 31.6%), and extremely severe stroke (NIHSS of 22–42, 53.5%; Fonarow et al., 2012). Little is known about the predictors of hospital discharge outcome in patients with stroke secondary to AF when treated with intravenous rtPA.

Purposes

The purposes of this study were twofold. First, we sought to directly compare patients with ischemic stroke with and without AF who were treated with intravenous rtPA. Examining risk factors and hospital discharge outcome between the two groups may help predict patients most likely to benefit from nursing interventions during acute care hospitalization. Second, we examined independent predictors of poor hospital discharge outcome (death or discharged to a skilled nursing facility, long-term acute care facility, or hospice care) in patients with stroke secondary to AF treated with intravenous rtPA. The results of this study may identify areas for future research and direct resources for treatment that may or may not be needed and/or wanted by patients and family members.

Methods

Participants

The study was approved by the Allegheny Singer Research Institute-West Penn Allegheny Hospital Institutional Review Board. A retrospective review of patients in a single-center acute stroke registry was performed. From January 2006 to December 2011, 358 patients were treated with intravenous rtPA for stroke at Allegheny General Hospital, a Primary Stroke Center certified by the Joint Commission. Inclusion criteria were (a) age ≥ 18 years, (b) diagnosis of stroke presenting ≤3 hours from symptom onset to the emergency department, and (c) treatment with intravenous rtPA. Exclusion criteria were (a) treatment with intra-arterial thrombolysis or mechanical clot disruption/extraction by endovascular therapy either alone or in combination with intravenous rtPA and (b) presence of cerebral infarction in bilateral cerebral hemispheres.

In this article, the investigators examine patients with stroke–those with and without atrial fibrillation–who were treated with tPA in an attempt to predict (1) the possible benefits of acute nursing interventions and (2) poor postdischarge outcomes.

Clinical data were collected by chart review and included age, initial stroke severity measured by NIHSS score, length of hospital stay (LOS), gender, hypertension, hyperlipidemia, diabetes mellitus, smoking status, right versus left hemisphere infarction, intubation, AF, and hospital discharge outcome. Radiographic data included the cerebral vascular territory of infarction by magnetic resonance imaging or computerized tomography. All patients received routine standard of care for the administration of intravenous rtPA as outlined in the Guidelines for Early Management of Adults with Ischemic Stroke (Adams et al., 2007).

Procedure

A descriptive, correlational design was used with secondary analysis of data from an existing database of patients with stroke treated with intravenous rtPA. Data for the database were collected retrospectively because patients' inpatient stroke evaluation can reveal preexisting conditions not diagnosed before the stroke. A vascular neurologist (A. T.) and nurse coordinator (M. T.) were responsible for maintaining the database. A data collection form was developed and used to collect the information. The information was then transferred into the database. All data points used in this study were preexisting and were analyzed.

Instruments

Stroke severity was rated by the admission NIHSS, which is an efficient and reliable measure of a patient's neurological status because of stroke and is used to assess outcome after a stroke (Summers et al., 2009). NIHSS scores were rated by individuals who completed online training and certification through the American Stroke Association. The NIHSS is a 13-item test designed

to assess a patient's neurological function and assign a score to the patient's severity of stroke. The scoring can range from 0 to 42 (0 = *normal, no deficit* to 42 = *the greatest disability*). A higher score indicates greater stroke severity and more disability.

Magnetic resonance imaging and computerized tomography brain images were reviewed by a vascular neurologist (A. T.) after treatment with intravenous rtPA to determine the radiographic extent of cerebral infarction. Large areas of cerebral infarction were defined as total anterior circulation infarction (TACI) using the Oxfordshire Community Stroke Project clinical classification of subtypes of cerebral infarction (Lindley, Wardlaw, Dennis, Slattery, & Sandercock, 1993).

Hospital discharge outcome was dichotomized as good or poor outcome in which good outcome was defined as hospital discharge to home or inpatient rehabilitation or signed oneself out against medical advice. Poor outcome was defined as in-hospital death or discharge to a skilled nursing facility, long-term acute care facility, or hospice care.

Statistical Analysis

SPSS (version 19, SPSS Inc.) was used for the analysis. Frequencies and descriptive statistics were performed to describe the patients receiving intravenous rtPA for stroke with and without AF. The *t* test was used to compare patients with AF versus no AF on continuous level data. A chi-square test was done to compare patients with AF versus no AF on categorical level data. A bivariate logistic regression was then conducted of the AF cohort to determine predictors of poor hospital discharge outcome. Finally, a multivariate logistic regression was performed of the AF cohort to assess independent predictors of poor hospital discharge outcome.

Results

As shown in Table 1, there were significant differences between the patients with ischemic stroke with AF (n = 144) and without AF (n = 190) who were treated with intravenous rtPA. The patients with AF compared with those without AF were older (79.4 vs. 66.5 years, $p < .0001$), had higher initial NIHSS scores (14.2 vs. 11.3, $p < .0001$), had longer LOS (8.8 vs. 6.2 days, $p < .0001$), were more likely women (59.7% vs. 46.8%, $p = .020$), had more hypertension (88.9% vs. 78.8%, $p = .015$), had less hyperlipidemia (63.2% vs. 78.7%, $p = .002$), had less cigarette smoking (19.3% vs. 41.3%, $p < .0001$), had higher rates of TACI (25.7% vs. 12.7%, $p = .003$), and had poor hospital discharge outcome (45.1% vs. 17.9%, $p < .0001$).

Table 2 shows the results of the bivariate logistic regression analysis to determine predictors of poor hospital discharge outcome in patients with stroke with AF treated with intravenous rtPA. Age (OR = 0.898, 95% CI [0.853, 0.945]), initial NIHSS scores (OR = 0.895, 95% CI [0.838, 0.955]), LOS (OR = 0.936, 95% CI [0.888, 0.987]), intubation (OR = 0.042, 95% CI [0.005, 0.331]), and TACI (OR = 0.053, 95% CI [0.017, 0.163]) were significant unadjusted predictors of poor hospital discharge outcome.

TABLE 1. Clinical Characteristics of Patients Receiving Intravenous Thrombolysis for Stroke With and Without Atrial Fibrillation

Characteristic	Patients With Atrial Fibrillation (n = 144)	Patients Without Atrial Fibrillation (n = 190)	t (p) or χ^2 (p)
Age (years), *M* ± *SD*	79.4 ± 9.3	66.5 ± 14.8	**−9.721 (<.0001)[a]**
Initial NIHSS, *M* ± *SD*	14.2 ± 6.2	11.3 ± 6.7	**−3.834 (<.0001)[a]**
LOS (days), *M* ± *SD*	8.8 ± 6.9	6.2 ± 5.4	**−3.764 (<.0001)[a]**
Gender (female), *n* (%)	86/144 (59.7)	89/190 (46.8)	**5.448 (.020)[b]**
Hypertension, *n* (%)	128/144 (88.9)	149/189 (78.8)	**5.905 (.015)[b]**
Hyperlipidemia, *n* (%)	91/144 (63.2)	148/188 (78.7)	**9.751 (.002)[b]**
Diabetes mellitus, *n* (%)	48/143 (33.6)	50/189 (26.5)	1.979 (0.160)[b]
Smoker, *n* (%)	27/140 (19.3)	78/189 (41.3)	**17.888 (<.0001)[b]**
Lateralization (right), *n* (%)	66/144 (45.8)	78/190 (41.1)	0.763 (.382)[b]
Intubation, *n* (%)	16/142 (11.3)	23/189 (12.2)	0.063 (0.801)[b]
TACI, *n* (%)	36/140 (25.7)	24/189 (12.7)	**9.138 (.003)[b]**
Hospital discharge outcome (poor), *n* (%)	65/144 (45.1)	34/190 (17.9)	**29.155 (<.0001)[b]**

Note. LOS = length of hospital stay; NIHSS = National Institutes of Health Stroke Scale; TACI = total anterior circulation infarction. [a]Student's *t* test. [b]Chi-square.

TABLE 2. Bivariate Logistic Regression Analysis of Poor Outcome in Patients With Stroke Secondary to Atrial Fibrillation Treated With Intravenous Thrombolysis

Characteristic	OR (95% CI)	Wald (*p*)
Age (years, *n* = 144)	**0.898 (0.853, 0.945)**	**17.186 (<.0001)**
Initial NIHSS (*n* = 125)	**0.895 (0.838, 0.955)**	**11.233 (.001)**
LOS (days, *n* = 142)	**0.936 (0.888, 0.987)**	**6.005 (.014)**
Gender (female, *n* = 144)	1.453 (0.740, 2.853)	1.175 (.278)
Hypertension (*n* = 144)	0.939 (0.329, 2.675)	0.014 (.906)
Hyperlipidemia (*n* = 144)	1.138 (0.577, 2.247)	0.140 (.709)
Diabetes Mellitus (*n* = 143)	0.977 (0.487, 1.962)	0.004 (.948)
Smoker (*n* = 140)	2.333 (0.944, 5.766)	3.370 (.066)
Lateralization (right, *n* = 144)	1.806 (0.929, 3.511)	3.041 (.081)
Intubation (*n* = 142)	**0.042 (0.005, 0.331)**	**9.078 (.003)**
TACI (*n* = 140)	**0.053 (0.017, 0.163)**	**26.343 (<.0001)**

Note. LOS = length of hospital stay; NIHSS = National Institutes of Health Stroke Scale; TACI = total anterior circulation infarction.

Employing a multivariate logistic regression analysis, age (OR = 0.879, 95% CI [0.804, 0.961]), LOS (OR = 0.925, 95% CI [0.858, 0.997]), and TACI (OR = 0.097, 95% CI [0.022, 0.432]) were significant independent predictors of poor outcome (Table 3).

Discussion

The main findings of this study are that patients with stroke with AF who are treated with intravenous rtPA are older, present with more severe strokes, and have a poorer clinical response to intravenous rtPA resulting in longer LOS, TACI (larger cerebral infarct), and poor hospital discharge outcomes in comparison with patients without AF. In addition, we found that increasing age, longer LOS, and TACI are significantly associated with poor hospital discharge outcome in patients with stroke secondary to AF.

Prior reports of patients with stroke with AF treated with intravenous rtPA have reported various outcomes measures (i.e., NIHSS, mortality, and the modified Rankin Scale score) administered at varied time points from discharge to 90 days after discharge (Banks & Marotta, 2007; Frank, Fulton, Weimar, Shuaib, & Lees, 2012; Kimura et al., 2009; Saposnik, Gladstone, Raptis, Zhou, & Hart, 2013). Similar to these reports, we found that increasing age and stroke severity based on the admission NIHSS scores are independently associated with poor outcomes (Frank et al., 2012; Kimura et al.,

TABLE 3. Multivariate Logistic Regression Analysis of Poor Outcome in Patients With Stroke Secondary to Atrial Fibrillation Treated With Intravenous Thrombolysis (*n* = 115)

Characteristic	OR (95% CI)	Wald (*p*)
Age (years)	**0.879 (0.804, 0.961)**	**8.028 (.005)**
Initial NIHSS	0.959 (0.873, 1.054)	0.749 (.387)
LOS (days)	**0.925 (0.858, 0.997)**	**4.104 (.043)**
Gender (female)	0.853 (0.280, 2.596)	0.079 (.779)
Hypertension	0.474 (0.067, 3.340)	0.562 (.454)
Hyperlipidemia	1.683 (0.531, 5.331)	0.782 (.376)
Diabetes mellitus	0.442 (0.145, 1.349)	2.057 (.151)
Smoker	1.412 (0.272, 7.335)	0.169 (.681)
Lateralization (right)	1.607 (0.526, 4.908)	0.694 (.405)
Intubation	0.000 (0.000, ~)	0.000 (.999)
TACI	**0.097 (0.022, 0.432)**	**9.383 (.002)**

Note. LOS = length of hospital stay; NIHSS = National Institutes of Health Stroke Scale; TACI = total anterior circulation infarction.

2009). Frank et al., however, reported that AF was not independently associated with adverse outcome after adjustment for age and stroke severity based on the day-90 modified Rankin Scale score. Saposnik et al. reported on 316 patients with stroke with AF treated with intravenous rtPA and found older age and more severe strokes compared with non-AF patients with worse outcomes (hospital-discharge modified Rankin Scale score = 3–6). We reported adverse outcomes based on the hospital discharge outcome.

Several risk factors were significantly different between patients with stroke with and without AF who were treated with intravenous rtPA and contributed to a significantly poor outcome in the patients with AF. The patients with AF tended to be older women with hypertension who had TACI (large cerebral infarct), worse initial NIHSS scores, and longer LOS. The Stroke Risk in Atrial Fibrillation Working Group (2007) found that patient age was a consistent independent risk factor for stroke in patients with AF. The AF is a prevalent chronic cardiac condition, and typically, these patients are under the medical care of specialists; therefore, their modifiable risk factors (i.e., diabetes and hypertension) may be closely monitored and treated. In contrast, we found increased rates of hyperlipidemia and smoking in the non-AF cohort compared with the AF cohort. One possible reason for the significantly higher rate of hyperlipidemia in the non-AF cohort was that these patients were younger and may be unaware of the condition. The higher rate of smoking in the non-AF cohort may be because of the higher rate of large vessel atherosclerotic disease as the cause of stroke. More community outreach and education at the primary care level can increase awareness of risk factors that people can control to prevent ischemic stroke.

Significant unadjusted characteristics that predicted poor outcome in the AF cohort were older age, more disabling strokes (TACI), and more severe strokes (higher NIHSS score). These factors contributed to the significantly greater likelihood of intubation and longer LOS in the patients with AF with poor hospital discharge outcome. In the adjusted analyses, only age, TACI, and LOS remained significant independent predictors. Patients with stroke secondary to AF with a poor hospital discharge outcome were 12% more likely to be older, 90% more likely to have TACI, and 7% more likely to have a longer LOS. As Dulli et al. (2003) reported, strokes secondary to AF are more severe than non-AF-related strokes. Prevention of stroke in the population with AF should be the primary focus of clinicians who see and treat this population. Treatment options for AF, especially in the older population, remain controversial despite advances and newer anticoagulants (Furie et al., 2012). Clinical trials support the use of warfarin and oral non-vitamin-K antagonist anticoagulants for patients with AF (Goldstein & Rothwell, 2012). The novel anticoagulants include the direct thrombin inhibitor, dabigatran, and factor Xa inhibitors rivaroxaban and apixaban, recently approved by the Food and Drug Administration for stroke prevention in AF. These new anticoagulants were tested in clinical trials against warfarin for the prevention of stroke secondary to AF. This new research helps support both novel and established therapies and improves strategies to add to the success of modern stroke prevention (Goldstein & Rothwell, 2012).

Strengths and Limitations

A strength of the study was that the NIHSS, a standardized tool, was administered by certified personnel. In addition, the patient population was recruited from a primary stroke center certified by the Joint Commission that used standardized protocols for the administration of intravenous rtPA. The sample size was moderate with fairly comparable numbers of patients in the AF and non-AF cohorts.

Limitations to this study included the secondary analysis of existing data; therefore, data were incomplete at times. Cause-and-effect relationships cannot be made because of the descriptive correlational design. Outcome was based on hospital discharge outcome, rather than a 3-month modified Rankin scoring, which is generally reported for stroke outcome but was not available. Findings can only be generalized to patients with stroke secondary to AF treated with intravenous rtPA.

Implications for Nursing

Stroke is a challenging disease that requires the efforts and skill of all members of the multidisciplinary team (Summers et al., 2009). Our results indicate two nonmodifiable variables that predict poor hospital discharge outcome in this AF stroke cohort: TACI (large cerebral infarct) and age. However, we found this group to have a longer LOS, on which nursing can have a significant impact. Neuroscience nurses often will coordinate the care of patients with stroke. Effective coordinated care of patients with stroke results in decreased LOS, improved outcomes, and decreased costs (Summers et al., 2009). Nursing can provide quality care by initiating the development of a daily multidisciplinary meeting that starts within 24 hours after hospital admission. Important members of the multidisciplinary team should include, but are not limited to, nursing; physical, occupational, and speech therapy; case management; and social work. Preexisting admission order sets can improve the process of managing the care of the patient with stroke, regardless of the etiology of the stroke or prognosis of the patient. If nurses coordinate the care across the healthcare continuum and start the stroke rehabilitation early in the inpatient setting, then the likelihood of death and disability within the first year

is reduced (Miller et al., 2010). Discharge planning and anticipating the needs of this vulnerable population can help the transition at discharge for patients and their families. Outpatient care is equally important because this setting is ideal to educate patients and families about adhering to medications, controlling the modifiable risk factors that put the patients at risk for stroke or a second stroke, and activating emergency services quickly at the onset of stroke symptoms.

Conclusions

With the aging population in the United States, healthcare providers will be confronted with an increasing stroke burden. AF is a severe chronic condition that was found in this study to be associated with poor hospital discharge outcome in patients with stroke treated with intravenous rtPA. This study suggested that these patients have a high probability of being severely disabled and requiring the care and assistance of another person. The independent predictors of poor hospital discharge outcome in these patients (older age, TACI, and longer LOS) may possibly be used to help counsel patients and families and may potentially add important information to end-of-life discussions, if indicated.

Acknowledgments

The authors wish to acknowledge Denise Charron-Prochownik, PhD, RN, CPNP, FAAN, Professor of Nursing at the University of Pittsburgh, for reviewing the manuscript.

References

Adams, H. P., Zoppo, G. D., Alberts, M. J., Bhatt, D. L., Brass, L., Furlan, A., … Wijdicks, E. F. (2007). Guidelines for the early management of adults with ischemic stroke. *Stroke*, *38*, 1655–1711. doi:10.1161/STROKEAHA.107.181486

American Stroke Association. (2012a). *Stroke treatments*. Retrieved from http://www.strokeassociation.org/STROKEORG/AboutStroke/Treatment/Treatment_UCM_310892_Article.jsp

American Stroke Association. (2012b). *Understanding risk*. Retrieved from http://www.strokeassociation.org/STROKEORG/AboutStroke/UnderstandingRisk/Understanding-Risk_UCM_308539_SubHomePage.jsp

Banks, J. L., & Marotta, C. A. (2007). Outcomes validity and reliability of the Modified Rankin Scale: Implications for stroke clinical trials: A literature review and synthesis. *Stroke*, *38*, 1091–1096. doi:10.1161/01.STR.0000258355.23810.c6

Centers for Disease Control and Prevention. (2010). *Atrial fibrillation fact sheet*. Retrieved from http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_atrial_fibrillation.htm

Dulli, D. A., Stanko, H., & Levine, R. L. (2003). Atrial fibrillation is associated with severe acute ischemic stroke. *Neuroepidemiology*, *22*, 118–123. doi:10.1159/000068743

Fonarow, G. C., Saver, J. L., Smith, E. E., Broderick, J. P., Kleindorfer, D. O., Sacco, R. L., … Schwamm, L. H. (2012). Relationship of National Institutes of Health Stroke Scale to 30-day mortality in Medicare beneficiaries with acute ischemic stroke. *Journal of the American Heart Association*, *1*, 42–50. doi:10.1161/JAHA.111.000034

Frank, B., Fulton, R., Weimar, C., Shuaib, A., & Lees, K. R. (2012). Impact of atrial fibrillation on outcome in thrombolyzed patients with stroke. Evidence from the virtual international stroke trials archive (VISTA). *Stroke*, *43*, 1872–1877. doi:10.1161/STROKEAHA.112.650838

Frankel, M. R., Morgenstern, L. B., Kwiatkowski, T., Lu M., Tilley, B. C., Broderick, J. P., … Brott, T. (2000). Predicting prognosis after stroke: A placebo group analysis from the National Institute of Neurological Disorders and Stroke rt-PA Stroke Trial. *Neurology*, *55*, 952–959.

Furie, K. L., Goldstein, L. B., Albers, G. W., Khatri, P., Neyens, R., Turakhia, M. P., … Wood, K. A. (2012). Oral antithrombotic agents for the prevention of stroke in nonvalvular atrial fibrillation: A science advisory for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *43*, 3442–3453. doi:10.1161/STR.0b013e318266722a

Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Borden, W. B., … on behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. (2013). Heart disease and stroke statistics—2013 update: A report from the American Heart Association. *Circulation*, *127*, e6–e245. doi:10.1161/CIR.0b013e31828124ad

Goldstein, L. B., Adams, R., Alberts, M. J., Appel, L. J., Brass, L. M., Bushnell, C. D., … Sacco, R. L. (2006). Primary prevention of ischemic stroke: A guideline from the American Heart Association/American Stroke Association Stroke Council. *Stroke*, *37*, 1583–1633. doi:10.1161/01.STR.0000223048.70103.F1

Goldstein, L. B., & Rothwell, P. M. (2012). Advances in prevention and health services delivery 2010–2011. *Stroke*, *43*, 298–299. doi:10.1161/STROKEAHA.111.642678

Kimura, K., Iguchi, Y., Shibazaki, K., Iwanaga, T., Yamashita, S., & Aoki, J. (2009). IV t-PA therapy in acute stroke patients with atrial fibrillation. *Journal of the Neurological Sciences*, *276*, 6–8. doi:10.1016/j.jns.2008.10.018

Lansberg, M. G., O'Donnell, M. J., Khatri, P., Lang, E. S., Nguyen-Huynh, M. N., Schwartz, N. E., … Akl, E. A. (2012). Antithrombotic and thrombolytic therapy for ischemic stroke. *CHEST*, *141*, e601S–e636S. doi:10.1378/chest.11-2302

Lindley, R. I., Wardlaw, C. P., Dennis, M. S., Slattery, J., & Sandercock, P. A. (1993). Interobserver reliability of a clinical classification of acute cerebral infarction. *Stroke*, *24*, 1801–1804. doi:10.1161/01.STR.24.12.1801

Miller, E. L., Murray, L., Richards, L., Zorowitz, R. D., Bakas, T., Clark, P., & Billinger, S. A. (2010). Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient. *Stroke*, *41*, 2402–2448. doi:10.1161/STR.0b013e3181e7512b

Saposnik, G., Gladstone, D., Raptis, R., Zhou, L., & Hart, R. G. (2013). Atrial fibrillation in ischemic stroke: Predicting response to thrombolysis and clinical outcomes. *Stroke*, *44*, 99–104. doi:10.1161/STROKEAHA.112.676551

Stroke Risk in Atrial Fibrillation Working Group. (2007). Independent predictors of stroke in patients with atrial fibrillation: A systematic review. *Neurology*, *69*, 546–554. doi:10.1212/01.wnl.0000267275.68538.8d

Summers, D., Leonard, A., Wentworth, D., Saver, J. L., Simpson, J., Spilker, J. A., … Mitchell P. H. (2009). Comprehensive overview of nursing and interdisciplinary care of the acute ischemic stroke patient. *Stroke*, *40*, 2911–2944. doi:10.1161/STROKEAHA.109.192362

You, J. J., Singer, D. E., Howard, P. A., Lane, D. A., Eckman, M. H., Fang, M. C., … Lip, G. Y. (2012). Antithrombotic therapy for atrial fibrillation: Antithrombotic therapy and prevention of thrombosis, 9th ed.: American College of Chest Physicians evidence-based clinical practice guidelines. *CHEST*, *141*, e531S–e575S. doi:10.1378/chest.11-2304

Instructions:

- Read the article. The test for this CE activity can only be taken online at www.NursingCenter.com/CE/JNN. Tests can no longer be mailed or faxed. You will need to create (its free!) and login to your Planner CE account before taking online tests. Your planner will keep track of all your Lippincott Williams & Wilkins online CE activities for you.
- There is only one correct answer for each question. A passing score for this test is 13 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Williams & Wilkins: 1-800-787-8985.

Registration Deadline: February 28, 2017

Disclosure Statement:

The authors and planners have disclosed that they have no financial relationships related to this article.

Provider Accreditation:

Lippincott Williams & Wilkins, publisher of *Journal of Neuroscience Nursing*, will award 2.0 contact hours for this continuing nursing education activity.

Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.0 contact hours. Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia and Florida, CE Broker #50-1223.

Your certificate is valid in all states.

Payment:

- The registration fee for this test is $21.95.
- AANN members can take the test for free by logging into the secure ''Members Only'' area of http://www.aann.org to get the discount code. Use the code when payment is requested when taking the CE test at www.NursingCenter.com/CE/JNN.

Notice: Online CE Testing Only in 2015!

Starting with the first issue of 2015, the tests for CE articles will appear only in the online version of the issue, and all tests must be completed online at (www.nursingcenter.com/ce/JNN). Simply select the CE article you are interested in. Both the article and the test are available there. You will no longer have the option to mail or fax in the test.

If you haven't done so already, you will want to create a user account for yourself in Nursing Center's CEConnection: it's free to do so! Look for the Login link in the upper right hand corner of the screen.