Impact of Neurological Follow-Up on Early Hospital Readmission Rates for Acute Ischemic Stroke

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Abstract

Introduction: Despite advances in stroke care, readmission rates for patients with ischemic stroke remain high. Although factors such as age, diabetes, and continuous use of antiplatelet agents have been found to predict readmission rates, the impact of after-hospital care has not been examined. **Methods:** The present study reviewed the charts of 416 patients with acute ischemic stroke and recorded stroke-related comorbidities, neurology follow-up within 21 days, readmission at 0 to 30 days, readmission at 31 to 90 days, and any reasons for readmission. **Results:** For those readmitted within 0 to 30 days, reasons for readmission were other medical conditions (62.5%), recurrent stroke (30.4%), and elective procedure (7.1%). For those readmitted within 31 to 90 days, reasons for readmission were other medical conditions (62.3%), recurrent stroke (15.1%), and elective procedure (22.6%). There was no significant relationship between being evaluated within 21 days and readmission at 0 to 30 or 31 to 90 days. However, those who did have a neurology follow-up at any point in time had a lower readmission rate of 10.6% compared to those who never came back (19.2%, $P = .017$). Patients with coronary artery disease and diabetes had a significantly higher likelihood of readmission within 0 to 30 days. **Conclusion:** The present study suggests that neurology follow-up at any point in time for patients with acute ischemic stroke may reduce short-term readmissions, but special attention to optimizing management of other underlying medical conditions, coronary artery disease, or diabetes may also help reduce overall readmissions. Patients with stroke, therefore, may benefit from a follow-up with both the primary care and neurology in a coordinated fashion to prevent early readmissions at 30 days.

Keywords

stroke, outcome, neurology, comorbidities

Introduction

Stroke represents the second most common cause of mortality and the third most common cause of disability worldwide, and although the overall rate of stroke-related mortality has decreased, the absolute number of individuals with stroke remains high and continues to increase.¹ In the United States, the annual incidence of new or recurrent stroke is 795 000, with 76% representing first-time strokes and 87% having an ischemic etiology.² The high prevalence of ischemic stroke becomes particularly important, given that the 30-day fatality rate ranges from 16% to 23%.³ This has prompted efforts to improve stroke care and to minimize complications.

One of the publicly reported measures of quality of care for hospitals is risk-standardized readmissions within 90 days. Since factors outside hospital control tend to increase over time, longer periods are not used. Readmission rates after

discharge for ischemic stroke range from 6.5% to 23.4%.⁴ Beyond 30 days, these readmission rates rise significantly, ranging from 23% to 30.7% at 6 months.⁵ Even if admitted

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to a certified primary stroke center, readmission rates do not significantly differ.⁶ By 1 year after initial hospitalization for ischemic stroke, as many as two-thirds of Medicare patients either died or had been rehospitalized.⁷ Moreover, fewer than 15% of patients admitted for ischemic stroke have been found to survive admission free within 5 years.⁸ Given the economic burden from stroke, efforts have been made to reduce post-stroke complications by better understanding patient features and hospital measures that predict readmission.⁹

A recent large retrospective study involving 138 668 patients with ischemic stroke across 5 states and 568 hospitals revealed unplanned readmissions as high as 15.2%.¹⁰ The investigators assessed the influence of patterns of hospital care, including diagnostic testing, procedures, intensive care unit admission, intravenous tissue plasminogen activator (IV tPA) administration, and other therapeutic modalities on readmission. They found that hospital practices such as occupational therapy and use of echocardiography appeared to play a role in reducing readmissions. The mechanism of effect on outcomes of these hospital practices remained complex and poorly understood. The purpose of the present study was to investigate the impact of early neurology follow-up (0-21 days postdischarge) on 0- to 30-day and 31- to 90-day hospital readmission rates for acute ischemic stroke.

Methods

As part of a medical student research project, a retrospective chart review was performed on patients admitted and treated at WellSpan York Hospital for ischemic stroke between October 2012 and June 2013. At the time of the study, WellSpan York Hospital was a primary stroke center. Patients were identified from a preexisting stroke database and through electronic health records. The study was approved by the study site's institutional review board, and a waiver of informed consent was granted.

The study population consisted of individuals 18 years and older admitted to WellSpan York Hospital and discharged with the diagnosis of ischemic stroke (*International Classification of Diseases, Ninth Revision* codes 433.01, 433.10, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, and 434.). Individuals younger than 18 years, patients with incomplete records, patients discharged with the diagnosis of hemorrhagic stroke, patients discharged with the diagnosis of transient ischemic attack, and individuals treated at or transferred to another facility were excluded from the study. No direct patient interaction or personal requirements were needed, and all the study information was obtained retrospectively.

Retrospective data were extracted from a cohort of patients prospectively maintained. Study investigators extracted data on a paper collection worksheet and populated an Excel spreadsheet. All study materials were stored in a password-protected location on a hospital server.

Table 1. Patient Demographics and Comorbidities.

	Number of Patients	Percentage
Gender		
Female	211	50.7
Male	205	49.3
Ethnicity		
White	369	88.7
Nonwhite	47	11.3
Comorbidity		
Hypertension	310	74.5
Dyslipidemia	169	40.6
Coronary artery disease	119	28.6
Atrial fibrillation	88	21.2
Smoking	83	20.0
Diabetes	130	31.3

The primary independent variables were: neurology follow-up attended within 1 to 21 days after discharge; attended a neurology follow-up (regardless of time frame); and never attended a neurology follow-up. This follow-up was with a stroke provider who reviewed the hospital record and made recommendations in stroke management. Primary dependent variables were readmission within 0 to 30 days and readmission within 31 to 90 days—cases that were readmitted at both times were excluded from analysis ($n = 2$). Other variables of interest were age, gender, marital status, insurance type, employment status, ethnicity, comorbid conditions (hypertension, dyslipidemia, coronary artery disease, atrial fibrillation, smoking, and diabetes), diseases burden (calculated by summing how many of the comorbid conditions they had: 0 = lowest, 6 = highest), National Institutes of Health Stroke Scale (NIHSS), IV tPA administration status, neurologic consultation, disposition (home, rehabilitation facility, skilled nursing home, expired, or other), and reason for readmission if applicable (eg, recurrent stroke/TIA, other medical, and elective procedure).

Data Analysis

Data were analyzed using the statistical analysis program, SPSS. Analysis included frequency and percentage determinations for all categorical parameters and mean and standard deviations for all continuous parameters. Specific statistical tests performed were χ^2 , tests of proportions, and t tests.

Results

A total of 416 patients met the criteria for inclusion into the study. Mean age of the sample was 70.8 years, of which 205 (49.3%) patients were male. The majority of the patient sample was Caucasian (88.7%). Patient comorbidities as defined by the American Heart Association's "Get with the Guidelines" are shown in Table 1. Fifty patients received IV tPA acutely (12%). The disease burden for the sample was 2.2

Table 2. Neurologic Follow-Up and Comorbidities of Patients Readmitted 0 to 30 Days and 31 to 90 Days After Discharge for Ischemic Stroke.

	Readmission 0 to 30 Days				Readmission 31 to 90 Days			
	No (n, %)		Yes (n, %)		No (n, %)		Yes (n, %)	
Not evaluated within 21 days	244	68.0	45	78.9	254	70.0	35	66.0
CAD ^a	93	25.9	26	45.6	104	28.7	15	28.3
Afib	71	19.8	17	29.8	75	20.7	13	24.5
DM ^a	104	29.0	26	45.6	110	30.3	20	37.7
Smoking	71	19.8	12	21.1	76	20.9	7	13.2
HTYN	266	74.1	44	77.2	268	73.8	42	79.2
Dyslipidemia	141	39.3	28	49.1	147	40.5	22	41.5

Abbreviations: CAD, Coronary Artery Disease; Afib, Atrial fibrillation; DM, Diabetes; HTYN, Hypertension.

^aSignificant difference between readmitted and nonreadmitted patients ($P < .05$).

(standard deviation [SD] = 1.3), indicating a low disease burden.

The neurology stroke team evaluated 84.9% (353) of the patients during their hospitalization. Of the 416 patients, 63.7% (265) had neurology follow-up in clinic at any point in time (2-1037 days, mean = 68.35) and 36.3% (151) had no record of ever returning for neurology follow-up. Of the 265 patients who had a neurology follow-up in clinic at any point in time, 47.5% (127) were seen within 21 days.

Readmission 0 to 30 Days

Fifty-seven (13.7%) patients with ischemic stroke were readmitted within 0 to 30 days after discharge. Of those readmitted, 75.4% did not have a 1- to 21-day neurology follow-up; however, this was not statistically significant compared to those who did have neurology follow-up within that time frame ($P = .094$). However, those who did have a neurology follow-up at any point in time had a lower readmission rate of 10.6% compared to those who never had neurology follow-up in clinic (19.2%, $P = .017$). For those readmitted within 30 days, reasons for readmission were other medical conditions (62.5%), recurrent stroke (30.4%), and elective procedure (7.1%). Of those readmitted for new stroke ($n = 17$), 50% were felt to be thrombotic, 50% were felt to be embolic, 2 patients had extracranial carotid disease of >50% stenosis of unclear significance, and in the rest, cause of stroke was unknown. Additionally, patients readmitted at 30 days had significantly higher rates of coronary artery disease (45.6%, $P = .002$) and diabetes (45.6%, $P = .012$). Smoking history, dyslipidemia, atrial fibrillation, and hypertension were not significantly higher in these patients. A comparison of these variables is depicted in Table 2. The mean disease burden for those readmitted at 0 to 30 days was 2.68. The initial admission NIHSS was not a significant factor for readmission ($P = .889$). Neurology consultation, gender, ethnicity, discharge disposition, employment status, and insurance type did not impact readmission rates at 30 days. Of those readmitted 0 to 30 days, 6 (10%) had IV tPA administration. None of these IV tPA patients were readmitted for elective

procedures, and the administration of tPA did not impact readmission at 0 to 30 days ($P = .830$).

Readmission 31 to 90 Days

Fifty-three (12.7%) patients with ischemic stroke were readmitted within 31 to 90 days after discharge. Patients not reevaluated at 1 to 21 days postdischarge were not any more likely to be readmitted to the hospital at 31 to 90 days ($P < .561$). Those who did have a neurology follow-up in clinic at any point in time did not have a significantly lower readmission rate (13.6%) compared to those who never had neurology follow-up (11.3%, $P = .494$). For those readmitted within 31 to 90 days, reasons for readmission were other medical conditions (62.3%), recurrent stroke (15.1%), and elective procedure (22.6%). Eight patients were readmitted with stroke. Data were available on 5 of these patients, of which 60% felt to be related to embolic strokes and only 2 patients had extracranial carotid disease of >50% of unclear significance. Unlike patients readmitted within 0 to 30 days after discharge, those readmitted at 31 to 90 days did not have significantly higher rates of coronary artery disease ($P = .958$) or diabetes (.275). Smoking history, dyslipidemia, and hypertension also did not differ compared to patients not readmitted 31 to 90 days. A comparison of these variables is depicted in Table 2. The mean disease burden for those readmitted 31 to 90 days was 2.2. The initial NIHSS also was not significant ($P = .169$). Once again, neurology consultation, gender, ethnicity, discharge disposition, employment status, and insurance type did not impact readmission rates at 31 to 90 days. Of those readmitted 31 to 90 days, 2 (3.6%) had IV tPA administration, and 1 of them was admitted for an elective procedure. Patients receiving IV tPA were not associated with lower readmission (13.3%) for the 31- to 90-day time window ($P = .067$).

Discussion and Conclusion

In the present study, 14% of patients with ischemic stroke were readmitted to the hospital within 30 days after discharge, which is similar to other large retrospective studies with

readmissions rates as high as 15.2%.¹⁰ Neurology follow-up within 1 to 21 days was not significantly associated with a reduction in readmission rates from all causes. However, those patients who never attended their neurology follow-up appointment trended toward an increase in readmissions at 0 to 30 days.

The significance of our findings remains unclear and likely due to the complex relationship of stroke with other comorbidities. A significant number of patients in our study readmitted within 30 days had a history of coronary artery disease or diabetes. Fareed et al reported among 9% of patients readmitted within 1 month of stroke discharge had these conditions and suggested that these conditions contribute to readmissions.¹¹ Similar findings have been reported in patients followed beyond 1 month after discharge, with patients with stroke having a significantly greater chance of being readmitted for heart failure, cardiac or vascular events, pneumonia, hip fractures, and repeat strokes.¹² This is consistent with our study in which 65% of patients readmitted at 0 to 30 days and 62.3% readmitted at 31 to 90 days were readmitted due to other medical conditions, whereas recurrent stroke was only 30.4% and 15.1%, respectively.

Similarity, Nahab et al investigated the frequency of avoidable readmissions among patients with stroke and other cerebrovascular disease. Patients with ischemic stroke represented 35% (945 patients) of their population, and they found that inadequate outpatient care coordination, incomplete initial evaluation, delayed palliative care consultation, and inadequate discharge instructions were associated with readmissions. The authors also found that having a neurology follow-up at discharge was associated with a trend toward lower 30-day readmission rates, which was similar to our findings.¹³

Due to the combination of patients with stroke having significant medical comorbidities and potential for considerable neurological sequelae, it would appear that early follow-up with both neurology and primary care could be beneficial in reducing readmission rates. As noted in the article above, the problem can often be coordination of outpatient care. Although early medical follow-up could ensure proper management of medical stroke risk factors, neurology follow-up could ensure optimal medical or surgical management to prevent future strokes and may serve as an opportunity to review and address stroke workup that occurred in the hospital. Neurology follow-up for the patients with stroke in this study included (1) review of the hospital record and those studies pending at the time of discharge such as autoimmune laboratories or hypercoagulation panels, (2) compliance with treatment of their secondary stroke risk factors, (3) need for antiplatelet and anticoagulation assessed, (4) stroke education regarding deficits and prognosis, and (5) further studies were ordered if warranted. For instance, a patient with stroke having an undetermined etiology suspicious for atrial fibrillation would have a 21-day event monitor ordered and followed up on. A failure to follow-up on such a patient may mean readmission for falls, syncope, or another stroke. Therefore, early

follow-up by both specialties may avoid critical diagnostic information going unaddressed.

While not shown in the results, our study also found that the use of tPA significantly decreased readmissions within the overall 0-90 day period. This is consistent with findings from the National Institute of Neurological Disorders and Stroke and the third International Stroke Trial, which suggest patients appropriately treated with tPA may entertain significant functional benefits months after their stroke compared to patients not receiving tPA.¹⁴⁻¹⁶ This may improve their ability to function independently and reduce readmissions related to disability. The use of tPA in our population may have produced a similar effect in the present study.

Our retrospective chart review had several limitations. The study population represented a modest sample from a single institution in a small community in central Pennsylvania. The small sample size alone may have contributed to the inability to detect small difference and reach statistical significance for patients with early neurology follow-up at 1 to 21 days. Also, demographically, the study population consisted of a roughly equal mix of male and female Caucasians, but it did not include a significant number of African American, Hispanic, or Asian patients, reflecting the ethnic makeup of the region—South Central Pennsylvania. In addition, not all patients received an early neurology follow-up, which also suggests there may be barriers to care such as not enough access to subspecialty providers or possibly disposition at hospital discharge. For instance in our data, patients who were discharged to home had a 17% greater likelihood of having an early neurology follow-up than those patients discharged outside of the system. Overall, neurology follow-up may play a role in reducing hospital readmissions, but the mechanism by which this occurs remains unclear. Future efforts to uncover the barriers to follow-up along with the effect of follow-up may identify useful strategies for optimizing patient health and reducing readmissions for patients with stroke.

Declaration of Conflicting Interests

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References

1. Feigin VL, Forouzanfar MH, Krishnamurthi R, et al. Global and regional burden of stroke during 1990-2010: findings from the Global Burden of Disease Study 2010. *Lancet*. 2014;383(9913):245-255.
2. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics—2013 update: a report from the American Heart Association. *Circulation*. 2013;127(1):e6-e245.
3. Feigin VL, Lawes CM, Bennett DA, Anderson CS. Stroke epidemiology: a review of population-based studies of incidence,

- prevalence, and case-fatality in the late 20th century. *Lancet Neurol.* 2003;2(1):43-53.
4. Lichtman JH, Leifheit-Limson EC, Jones SB, et al. Predictors of hospital readmission after stroke: a systematic review. *Stroke.* 2010;41(11):2525-2533.
 5. Li HW, Yang MC, Chung KP. Predictors for readmission of acute ischemic stroke in Taiwan. *J Formos Med Assoc.* 2011; 110(10):627-633.
 6. Lichtman JH, Leifheit-Limson EC, Jones SB, Wang Y, Goldstein LB. 30-day risk standardized mortality and readmission after ischemic stroke in critical access hospitals. *Stroke.* 2012; 43(10):2741-2747.
 7. Fonarow GC, Smith EE, Reeves MJ, et al. Hospital-level variation in mortality and rehospitalization for Medicare beneficiaries with acute ischemic stroke. *Stroke.* 2011;42(1):159-166.
 8. Bravata DM, Ho SY, Meehan TP, Brass LM, Concato J. Readmission and death after hospitalization for acute ischemic stroke: 5 year follow up in the Medicare population. *Stroke.* 2007;38(6): 1899-1904.
 9. Lloyd-Jones D, Adams RJ, Brown TM, et al. Heart disease and stroke statistics—2010 update: a report from the American Heart Association. *Circulation.* 2010;121(7):e46-e215.
 10. Burke JF, Skolarus LE, Adelman EE, Reeves MJ, Brown DL. Influence of hospital-level practices on readmission after ischemic stroke. *Neurology.* 2014;82(24):2196-2204.
 11. Fareed M, Suri K, Qureshi AI. Readmission within 1 month of discharge among patients with acute ischemic stroke: results of the University HealthSystem Consortium Stroke Benchmarking study. *J Vasc Interv Neurol.* 2013;6(2): 47-51.
 12. Lakshminarayan K, Schissel C, Anderson DC, et al. Five-year rehospitalization outcomes in a cohort of patients with acute ischemic stroke: Medicare linkage study. *Stroke.* 2011;42(6): 1556-1562.
 13. Nahab F, Takesaka J, Mailyan E, et al. Avoidable 30-day readmissions among patients with stroke and other cerebrovascular disease. *Neurohospitalist.* 2012;2(1):7-11.
 14. Wardlaw JM, Murray V, Berge E, del Zoppo G, Sandercock P, Lindley RL. Recombinants tissue plasminogen activator for acute ischaemic stroke: an updated systematic review and meta-analysis. *Lancet.* 2012;379(9834):2364-2372.
 15. Tissue plasminogen activator for acute ischemic stroke. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. *N Engl J Med.* 1995;333(24): 1581-1587.
 16. The IST-3 collaborative group. The benefits and harms of intravenous thrombolysis with recombinant tissue plasminogen activator within 6 h of acute ischaemic stroke (the third international stroke trial [IST-3]): a randomized controlled trial. *Lancet.* 2012; 379(9834):2353-2363.