Regional Intervention of Stroke Care to Increase Thrombolytic Therapy for Acute Ischemic Stroke

The Southeast Texas Experience

Rahul H. Damani, MD, MPH; Samyuktha Anand, MBBS; Parisa Asgarisabet, MBA; Catherine Bissell, RN; Sean Savitz, MD; Jose I. Suarez, MD

Background and Purpose—The aims of this study were to investigate the effect of an intervention to unblind data on r-tPA (recombinant tissue-type plasminogen activator) administration and sharing data with chief executive officers of participating hospitals, on r-tPA administration rates postintervention and on potential healthcare cost savings implemented at 26 Southeast Texas Regional Advisory Council hospitals.

Methods—Retrospective analysis of prospective data on thrombolytic therapy from 26 Southeast Texas Regional Advisory Council hospitals, collected between April 2014 and June 2016. The control (blinded) period (Q2-2014 to Q2-2015) was followed by unblinding (Q3-2015).

Results—Intervention was associated with 21.1% increase in r-tPA administration rates, with 38.5% increase in r-tPA administration with door-to-needle time ≤60 minutes. An absolute increase in r-tPA administration of 2.1% was seen with an average lifetime cost savings of $3.6 million.

Conclusions—Transparent regional data sharing was associated with improved r-tPA administration and healthcare cost savings. **(*Stroke*. 2018;49:2008-2010. DOI: 10.1161/STROKEAHA.118.021109.)**

Key Words: cost savings ■ hospitals ■ prospective studies ■ retrospective studies ■ stroke, acute ■ thrombolytic therapy

Acute ischemic stroke (AIS) is a neurological emergency that carries significant morbidity and mortality, with improvement in clinical outcomes demonstrated by r-tPA (recombinant tissue-type plasminogen activator) administration ≤4.5 hours after symptom onset. Patients treated within 90 minutes from symptom onset have an increased likelihood of favorable 90-day outcomes compared with those treated later.[1,2] Even though 25% of all patients with AIS are eligible for intravenous thrombolysis, only 7% of them receive this treatment in the United States.[3] Current efforts focus on increasing r-tPA administration rates and reducing treatment delays or door-to-needle times (DTN). The American Stroke Association launched the Target Stroke initiative with the goal of improving DTN times.[4] Recent analyses of the Get With The Guidelines-Stroke database show that <60% of patients receive r-tPA within 60 minutes.[5] Delays in r-tPA administration are associated with higher odds of mortality and higher rates of symptomatic intracerebral hemorrhage.[5]

AIS is also associated with significant cost to the US healthcare system. The mean lifetime cost of AIS in the United States is estimated at $140 048, which includes costs of inpatient care, rehabilitation, and follow-up.[6] The average lifetime cost saving of r-tPA administration for AIS is $25 000 (95% CI, −$11 000 to −$42 000) per patient.[7] Increasing the rates of r-tPA administration can decrease acute stroke morbidity and healthcare expenditure.

The Southeast Texas Regional Advisory Council (SETRAC) is 1 of 22 regional advisory councils currently functioning within the state of Texas. SETRAC coordinates emergency providers to ensure efficient and consistent care of each individual who experiences acute injury, including stroke. Hospitals treating patients with AIS within SETRAC voluntarily provide quarterly data on patient demographics, modes of transportation, treatment with r-tPA, and time to treatment. The SETRAC stroke committee reviews the blinded data periodically and recommends improvement of care provided to patients with AIS. One recommendation was the unblinding of data regarding r-tPA administration rates to chief executive officers (CEOs) of participating institutions. This study aims to investigate the effect of the SETRAC recommendation

Received January 8, 2018; final revision received June 4, 2018; accepted June 12, 2018.

From the Division of Vascular Neurology and Neurocritical Care, Department of Neurology, Baylor College of Medicine, Houston, TX (R.H.D., S.A.); University of Texas Health Science Center at Houston School of Public Health (P.A.); Southeast Texas Regional Advisory Council, Houston (C.B.); Department of Neurology, McGovern School of Medicine, Houston, TX (S.S.); and Division of Neurosciences Critical Care, Department of Anesthesiology and Critical Care Medicine (J.I.S.), Department of Neurology (J.I.S.), and Department of Neurosurgery (J.I.S.), Johns Hopkins University School of Medicine, Baltimore, MD.

The online-only Data Supplement is available with this article at https://www.ahajournals.org/journal/str/doi/suppl/10.1161/STROKEAHA.118.021109.

Correspondence to Rahul H. Damani, MD, MPH, Department of Neurology, Baylor College of Medicine, 7200 Cambridge St, MS BCM 609, Houston, TX 77030. Email rahul.damani@bcm.edu

to share data with CEOs of participating hospitals on r-tPA administration rates and potential healthcare cost savings.

Methods

Study Population

We performed a retrospective analysis of prospectively collected data from 26 hospitals participating in the SETRAC stroke committee. All patients discharged with a diagnosis of AIS, who received thrombolytic therapy with r-tPA between April 2014 and June 2016, were included in the study. The study was approved with a waiver of consent by the Institutional Review Board of the Baylor College of Medicine in Houston, TX. The data that support the findings of this study are available from the corresponding author on reasonable request.

Intervention

Data collection started in April 2014. During the first quarters of data review (control period from Q2-2014 to Q2-2015), the CEOs of participating hospitals received a quarterly report indicating the rates of patients treated with r-tPA at each institution in a blinded fashion except for identification of their program. In Q3-2015, decision was made to unblind names of all participating institutions that allowed CEOs to know which hospitals in the SETRAC region were treating patients with AIS and their corresponding rates of r-tPA use. The SETRAC Stroke Committee's intention was to provide participating hospitals with an incentive to improve performance in r-tPA administration. CEOs were encouraged to implement programs to increase awareness of AIS, including time-dependent interventions among healthcare professionals, such as emergency physicians and nurses; specifics of program can be found in the online-only Data Supplement.

Statistical Analysis

Variables are summarized as means±SD. All variables were tested for normality before further analyses. A Panel Poisson model was used to analyze effect of intervention during a period of 9 quarters. Given high within variance, a fixed effects model was chosen. Baseline demographics, including mean age, sex, race, and ethnicity, were collected along with the number of AIS and r-tPA administration rate (≤60 minutes DTN and >60 minutes DTN). Data collected from initial 5 quarters represent the control period and the next 4 quarters represent the intervention period. We compared change in r-tPA administration rate from control period to intervention period, and this was dichotomized between DTN ≤60 minutes and DTN >60 minutes. Univariate and multivariate analyses were performed. Statistical analysis was performed using Stata, version 14 (Stata Corp LLC, College Station, TX).

Results

Between April 2014 and June 2016 (total of 9 quarters), a total of 18 341 patients were discharged from 26 SETRAC facilities with a diagnosis of stroke. Among them, 14 675 (79.2%) were diagnosed with AIS. A total of 2218 (15.1%) patients received r-tPA; among them, 1707 (76.9%) patients received r-tPA at the SETRAC facility, whereas 511 (23.1%) received r-tPA at an outside hospital before transfer to a SETRAC facility. A DTN time of ≤60 minutes after emergency room arrival, among all facilities, was achieved in 1024 patients (median, 59.63%). Baseline characteristics and demographics in preintervention and postintervention period were similar (Table 1).

A univariate analysis showed that intervention was associated with significantly higher number of r-tPA administration rates with incident rate ratio 1.21 (95% CI, 1.07–1.37; P=0.002), furthermost benefit was seen in r-tPA administration with DTN ≤60 minutes incident rate ratio 1.38 (CI, 1.11–1.71; P=0.003). This statistically significant trend continued on multivariate logistical regression model after controlling for age, sex, ethnicity, and number of ischemic strokes (Table 2).

The intervention was associated with a 21.2% (P=0.002; mean absolute, 2.1% from 10.7% to 12.8%) increase in r-tPA administration with the most effect seen in r-tPA administration with DTN ≤60 minutes—an increase by 38.5% (P=0.003). In other words, intervention increased the total number of r-tPA administration by increasing a more favorable administration pattern of DTN ≤60 minutes.

To analyze effect of healthcare cost saving from intervention, we analyzed the increased number of patients who would have received r-tPA from intervention. The absolute increase in r-tPA administration rate adjusting for number of quarters would translate into 147 patients who got r-tPA who otherwise would not have received it if it were not for

Table 1. Baseline Characteristics

	All	Control Period	Intervention Period	*P* Value
No. of ischemic strokes, n	14 675	8068	6608	0.83
Sex: male, %	48.9	46.4	47.4	0.49
Mean age, y; mean (SD)	67.7 (5.60)	67.0 (3.99)	68.5 (6.93)	0.54
Race, %				
White	37.2	39.0	36.2	0.51
Black	16.0	16.6	15.4	0.95
Ethnicity: Hispanic, %	11.2	10.2	12.3	0.35

Table 2. Univariate and Multivariate Analysis Predictors of r-tPA Administered

	IRR (95% CI)	*P* Value
r-tPA		
Male patients, %	0.87 (0.48–1.56)	0.64
Mean age, y	0.99 (0.97–1.01)	0.45
White patients, %	0.99 (0.99–1.00)	0.45
Hispanic patients, %	1.00 (0.99–1.01)	0.577
No. of ischemic strokes	1.002 (1.0007–1.004)	0.005
Intervention	1.21 (1.07–1.37)	0.002
r-tPA (DTN ≤60 min)		
Male patients, %	0.71 (0.31–1.64)	0.43
Mean age, y	0.99 (0.96–1.02)	0.73
White patients, %	0.99 (0.99–1.003)	0.34
Hispanic patients, %	1.01 (0.99–1.04)	0.18
No. of ischemic strokes	0.003 (0.0007–0.005)	0.009
Intervention	1.38 (1.11–1.71)	0.003

DTN indicates door-to-needle time; IRR, incident rate ratio; and r-tPA, recombinant tissue-type plasminogen activator.

intervention. r-tPA administration was associated with average lifetime cost saving of $25 000 (95% CI, −$11 000 to −$42 000) per patient.[7] Extrapolating those numbers to our study would result in an average cost saving of $3.6 million ($1.6 to $6.1 million).

Discussion

Our data suggest that the intervention resulted in an increase in r-tPA administration within the first 60 minutes of hospital arrival by 38.5% and an increase in total r-tPA administration by 21.2% among SETRAC hospitals. Healthcare cost savings resulting from increased r-tPA utilization rates secondary to the intervention resulted in savings of >$3.67 million during 4 quarters of intervention period. This reflects significant improvement in patient care and healthcare spending with a simple, novel, noninvasive, and easy-to-implement intervention.

Strengths and Weaknesses

Our study has several strengths. Our data include information of all patients with AIS admitted to the SETRAC region. The data fields are similar to those validated by the Get With The Guidelines-Stroke database. The study intervention represents a simple instrument that should be applicable to other regions in the United States and possibly in other countries. Inability to control for unidentified confounding factors because of retrospective analysis is a limitation of the study.

Implications of Our Study

Only fraction of eligible patients with AIS receive r-tPA[3]; although various individual variables have been identified[8] as rate-limiting factors for r-tPA administration and achieving DTN ≤60 minutes, few studies address the need of overcoming limiting factors at institutional level.[9] Our study is unique because it addresses this limiting block. Our intervention is designed to increase transparency among hospitals in region at the highest administrative level. This simple strategy translates to improvement at hospital level and entire regional care. This is reflected by SETRAC hospital rates of r-tPA administration and DTN ≤60 minutes rate when compared with national average.

Conclusions

A larger prospective study is needed to further confirm the effectiveness of such novel intervention. However, we can infer that regional intervention for stroke systems of care, data sharing, and a simple intervention of providing feedback to hospital administrators can increase r-tPA administration rates for AIS.

Acknowledgments

Statistical analysis was done by P. Asgarisabet.

Disclosures

None.

References

1. Marler JR, Tilley BC, Lu M, Brott TG, Lyden PC, Grotta JC, et al. Early stroke treatment associated with better outcome: the NINDS rt-PA stroke study. *Neurology*. 2000;55:1649–1655.
2. Saver JL, Fonarow GC, Smith EE, Reeves MJ, Grau-Sepulveda MV, Pan W, et al. Time to treatment with intravenous tissue plasminogen activator and outcome from acute ischemic stroke. *JAMA*. 2013;309:2480–2488. doi: 10.1001/jama.2013.6959
3. Schwamm LH, Ali SF, Reeves MJ, Smith EE, Saver JL, Messe S, et al. Temporal trends in patient characteristics and treatment with intravenous thrombolysis among acute ischemic stroke patients at Get With The Guidelines-Stroke hospitals. *Circ Cardiovasc Qual Outcomes*. 2013;6:543–549. doi: 10.1161/CIRCOUTCOMES.111.000303
4. Fonarow GC, Smith EE, Saver JL, Reeves MJ, Hernandez AF, Peterson ED, et al. Improving door-to-needle times in acute ischemic stroke: the design and rationale for the American Heart Association/American Stroke Association's target: stroke initiative. *Stroke*. 2011;42:2983–2989.
5. Kamal N, Sheng S, Xian Y, Matsouaka R, Hill MD, Bhatt DL, et al. Delays in door-to-needle times and their impact on treatment time and outcomes in Get With The Guidelines-Stroke. *Stroke*. 2017;48:946–954. doi: 10.1161/STROKEAHA.116.015712
6. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics–2014 update: a report from the American Heart Association. *Circulation*. 2014;129:e28–e292. doi: 10.1161/01.cir.0000441139.02102.80
7. Boudreau DM, Guzauskas GF, Chen E, Lalla D, Tayama D, Fagan SC, et al. Cost-effectiveness of recombinant tissue-type plasminogen activator within 3 hours of acute ischemic stroke: current evidence. *Stroke*. 2014;45:3032–3039. doi: 10.1161/STROKEAHA.114.005852
8. Metts EL, Bailey AM, Weant KA, Justice SB. Identification of rate-limiting steps in the provision of thrombolytics for acute ischemic stroke. *J Pharm Pract*. 2017;30:606–611. doi: 10.1177/0897190016674408
9. Paul CL, Ryan A, Rose S, Attia JR, Kerr E, Koller C, et al. How can we improve stroke thrombolysis rates? A review of health system factors and approaches associated with thrombolysis administration rates in acute stroke care. *Implement Sci*. 2016;11:51. doi: 10.1186/s13012-016-0414-6