Medical University of South Carolina Telestroke: A Telemedicine Facilitated Network for Stroke Treatment in South Carolina—A Progress Report

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Abstract

Background: *Patients in rural communities lack access to acute stroke therapies. Rapid administration of lytic therapy increases the likelihood of favorable functional outcome in acute ischemic stroke (AIS). At the Medical University of South Carolina (MUSC), we implemented a Web-based telestroke program that allows patients presenting with AIS at a rural hospital to receive expert stroke consultation within minutes. This increases their chances of receiving lytic therapy, and therefore increases the likelihood of good functional outcome.*

Objectives: *Our study aims to provide an update on how our telestroke program had developed and the rate and safety of intravenous (IV) alteplase administration through telestroke.*

Methods: *Data were collected on all patients evaluated through the MUSC Telestroke program from May 2008 through April 2014. Collected data included National Institutes of Health Stroke Scale (NIHSS) on presentation, number of IV alteplase administrations, number of patients transferred to MUSC, number of mechanical thrombectomies performed on transferred patients, rate of symptomatic intracerebral hemorrhages (sICHs), and discharge location.*

Results: *A total of 7,694 consults were performed during the study period. Of them 3,795 (49.2%) patients were diagnosed with ischemic stroke, of those 1,324 (34.8%) received IV alteplase. A total of 1,282 patients were transferred to MUSC for further care. From November 2014 to April 2016, 56 patients received mechanical thrombectomy. sICH occurred in 33 patients who received alteplase, and in 5 patients receiving a combination of IV and intraarterial thrombolysis. Over the study period, the number of participating sites increased from 6 to 19 sites. The percentage of transfers to MUSC decreased from 36% to 14%.*

Conclusions: *Our study shows that our telestroke program had evolved over time to involve more sites throughout the state of South Carolina. Post-IV alteplase sICH was low and within the expected range.*

Keywords: *telemedicine, e-health, teleneurology, telehealth, telestroke*

Introduction

The goal of therapy in acute ischemic stroke (AIS) is to preserve tissue in the ischemic penumbra, where perfusion is decreased but sufficient to stave off infarction. Tissue in this area can be preserved by restoring blood flow to the compromised area and optimizing collateral flow.

Current treatment strategies approved for AIS treatment involve administration of alteplase (intravenous [IV] recombinant tissue-type plasminogen activator [rtPA]),[1,2] and endovascular thrombectomy.[3–7] These treatments should be implemented as soon as possible.

Many physicians lack experience or comfort administering alteplase, which has a 6% symptomatic hemorrhage rate.[1] Evidence supports the use of telemedicine in acute stroke care. With telemedicine an opinion for or against the use of alteplase in suspected stroke cases can be obtained when on-site stroke expertise is not available. Telemedicine is also helpful in deciding whether endovascular therapy should be considered.[8] The American Stroke Association guidelines for early management of adults with ischemic stroke recommend implementation of telemedicine to increase access to acute stroke care in neurologically underserved areas.[9]

In 2011, Lazaridis et al. reported early experience with clinical outcome of a telestroke system that began in 2008. A total of 965 consults were performed at 12 sites and IV alteplase was administered to 185 patients, while 15 patients received combination of IV and intraarterial thrombolysis. Eleven patients received intraarterial therapy only. Three patients (1.6%) who received IV alteplase alone and one patient who received combined therapy (6.7%) developed symptomatic intracerebral hemorrhage (sICH).[10]

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In 2012, Adams et al. reported the initial operational experience of the Medical University of South Carolina (MUSC) REACH Telestroke program. The program covered 15 sites with 2,482 inpatient beds and 471,875 emergency department visits annually. Eight academic faculty members from MUSC worked with 165 emergency department physicians and 325 nurses to provide 1,085 consults during the time period between May 2008 and April 2011. Of the 1,085 patients evaluated, 255 were recommended for treatment of IV alteplase, and of this set, alteplase was administered in 231 cases. The symptomatic hemorrhage rate in patients who received IV alteplase was 3%. Just more than 50% of patients were discharged home.[11]

The purpose of this report is to provide updated information on the clinical and operational outcomes of our MUSC Telestroke program since it was established in 2008.

Table 1. Number of Consults and Transfers Since the Establishment of the Telestroke Program

	TOTAL CONSULTS	NO. OF TRANSFERS—MUSC	% TRANSFERS—MUSC	NO. OF TRANSFERS—OTHER	% TRANSFERS—OTHER
2008	87	31	36	0	0
2009	231	112	48	0	0
2010	539	201	37	2	0
2011	988	216	22	11	1
2012	1,185	234	20	108	9
2013	951	243	26	54	6
2014	1,247	217	17	112	9
2015	1,857	302	16	113	6
2016	620	87	14	28	5

MUSC, Medical University of South Carolina.

Methods

Data were reviewed for the records of all patients evaluated with the MUSC Telestroke consultation network from May 1, 2008, through April 6, 2016. Source documents included the MUSC Telestroke consult note and either the medical record from the hospitalization at the partner hospital or the MUSC hospital record if the patient was transferred after the consult. Specific data included National Institutes of Health Stroke Scale (NIHSS) on presentation and number of alteplase administrations. Symptomatic hemorrhage rate and discharge disposition were recorded for all patients transferred to MUSC. Hemorrhages were classified as symptomatic or asymptomatic based on the European Cooperative Acute Stroke Study.[12] Discharge disposition was determined from medical record review and classified into five categories: home, acute rehab, nursing facility, hospice, and other hospital or dead. Discharge to home or rehab indicates positive outcomes. In addition, we evaluated the number of consults, door-to-treatment times, and transfer rates.

Results

CLINICAL OUTCOMES

The clinical outcomes are reported on patients who transferred to MUSC, and received IV alteplase, mechanical thrombectomy, or both therapies.

A total of 7,694 stroke consults were performed from May 1, 2008, through April 6, 2016. Of these, 3,795 (49.2%) patients were diagnosed with AIS and of these 1,324 (34.8%) received alteplase. The remaining patients either did not meet inclusion criteria for IV alteplase administration or had a contraindication. A total of 1,108 (83.7%) have documented administration times. Among the patients diagnosed with AIS, 1,282 (33.8%) were transferred to MUSC for further care (*Table 1*). Of the 1,324 receiving alteplase, 717 (54%) were transferred to MUSC for further care. sICH occurred in 33 (4.6%) of these transferred patients who received alteplase and in 5 patients receiving a combination of IV and intraarterial thrombolysis.

Among the 717 patients who received alteplase and transferred to MUSC, 379 (53%) were discharged home and 164 (23%) to rehab. Overall 76% of patients treated had good outcomes.

Data on intraarterial therapy were collected from November 2014 until April 6, 2016 following the publication of the first positive thrombectomy trial. A total of 27 telestroke transfer patients received a combination of IV and intraarterial thrombolysis and 29 patients received thrombectomy only. Of these, 21 (37%) patients were discharged home and 28 (50%) patients were discharged to rehab. Overall, 87% of these patients had good functional outcomes.

OPERATIONAL OUTCOMES

The number of participating sites covered by the MUSC Telestroke network has grown since inception from 6 telestroke sites in 2008 to 19 sites in 2016. Over the past 5 years, 7 of 18 partner hospitals have obtained and maintained Joint Commission Primary Stroke Certification (JCPSC) because of their telestroke affiliation with MUSC.

The number of rtPA administered over telestroke increased from 28 cases in 2008 to 336 cases in 2015.

Average door-to-needle times decreased from 98.8 min in 2008 to 66.5 min in 2015.

The overall combined program transfer rate to MUSC dropped from a high of 48% in 2009 to 16% in 2015.

Discussion

Since inception of the MUSC Telestroke program, there has been notable progress with regard to alteplase usage within the network (28 in 2008 vs. 336 in 2015).

Despite this increase in number of alteplase administrations, the complication rates have remained within the acceptable range (4.6% symptomatic hemorrhage rate), which falls well within expected benchmarks.[1] In addition, overall door-to-needle times have decreased dramatically from an average of 98.8 min in 2008 to 66.5 min in 2015 despite the addition of new sites. Reductions in door-to-needle times are likely secondary to robust education and 7 of 18 partner hospitals obtaining and maintaining JCPSC. We also hypothesize that the reason behind the reduction of transfers to MUSC is largely because of several factors. The increased comfort of the sites gained from experience and continued education, leading to Primary Stroke Certification and the creation of a local subhub. Subhubs are identified Primary Stroke Certified sites in the network with the ability and willingness to accept transfers from other regional hospitals. Patients requiring a higher level of care, but not eligible for intraarterial therapy, are transferred to these local subhub partner sites, allowing patients and families to stay closer to home and reserving beds at the primary hub for the sickest patients.

Future goals to improve patient outcomes and increase alteplase administration rates include continued efforts to reduce door-to-registration times, registration-to-call times, and log on-to-evaluation times. Efforts will be focused on increasing education of partner sites regarding the importance of early treatment. MUSC Telestroke will begin focusing on "door in–door out" times with partner sites. This effort is intended to decrease transfer times to MUSC and other Comprehensive Stroke Center partners to get potential thrombectomy candidates to centers faster.

Given that only a small percentage of the transfers to MUSC receive thrombectomy, our goal is to focus on developing and implementing a transfer back "boomerang," "drip, ship, ship" system that allows MUSC to transfer patients who are not thrombectomy candidates back to partner sites. This will allow MUSC to collaborate with more community hospitals and provide expert stroke care for more patients in their communities.

Conclusions

The MUSC Telestroke program began in 2008 as a hub and spoke program. Today, the program has evolved into a robust, statewide partnership between MUSC Comprehensive Stoke Program and 18 partner hospitals. This partnership has resulted in an increase in alteplase administrations to acute stroke patients with reduced door-to-needle times. The partnership affords patients to remain in their communities as partner hospitals have elevated stroke care capabilities by obtaining and maintaining JCPSC. Access to expert stroke care continues to improve for patients through the development of partner sites. Additional expert stroke care access is improving in the subacute and chronic stroke care phases through follow-up and outpatient consultative services.

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Disclosure Statement

No competing financial interests exist.

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